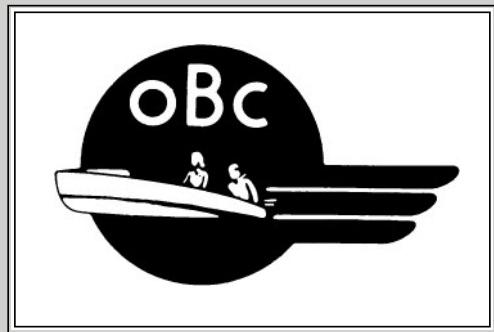
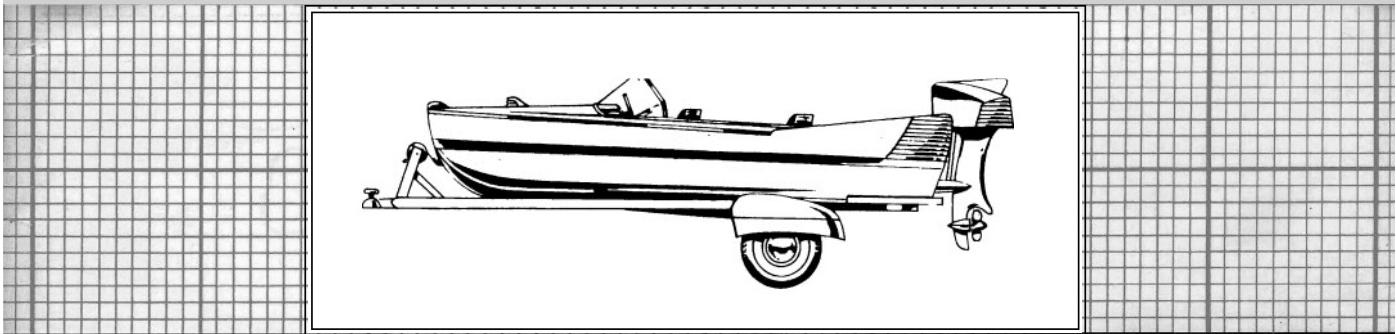


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OBC STANDARDS MANUAL



*Recommended practices
for the manufacturer of :*
OUTBOARD BOATS
OUTBOARD MOTORS
OUTBOARD BOAT TRAILERS
MARINE FITTINGS



This ebook adaptation is presented by BoatsInTheBelfry.com for research aiding in restoration of vintage boats, motors and trailers for display and use. As a disclaimer, please keep in mind that this information is one-half century old. The safety guidelines and in particular - fuel and fire safety guidelines are not to be used in any sense except as historical reference.

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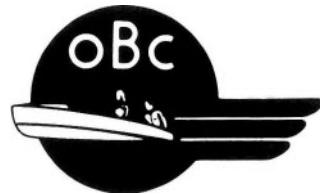
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1959 OBC

STANDARDS MANUAL



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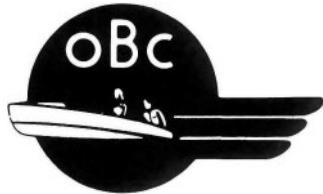
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1959

OBC STANDARDS MANUAL

Your trade association for the outboard industry, The Outboard Boating Club of America, has prepared this second edition of the OBC Standards Manual of recommended practices for outboard manufacturers.

As in the first edition, the 1959 edition of the Manual is designed to help manufacturers:

1. Build safer and better products.
2. "Match" their products with companion products so that the industry provides a boat-motor-trailer package.
3. Have the benefit of the best thinking in the industry set forth in specific terms as recommended practices.

The Manual not only contains new recommended practices, but every recommended practice has been carefully reviewed and improved by the various engineering committees. Therefore, the Manual warrants careful review.

As evidence of the extent to which the manufacturer members of OBC intend to establish performance standards, the OBC Boat Test Committee has been recently established, under the sponsorship of the OBC Engineering Coordination Committee.

This Boat Test Committee has a three-fold purpose:

1. To propose a long-range program for OBC testing to develop recommended practices for the outboard boat industry.
2. To work out, where necessary, specific tests to improve the present boat rating program of OBC.
3. To explore the possibilities of the use of instruments in our test work so the OBC standards program can continue to emphasize performance standards rather than design, material and construction standards.

This committee is already at work on devising instrumented tests for boat performance and hull durability to insure satisfactory life in rough usage.

It should be realized that the OBC engineering committees are exploring what is substantially virgin territory. The work of the committees thus far indicates that performance standards rather than design, material and construction standards are preferred in this fast-developing outboard industry.

Preliminary plans are being made for the issuance of the next issue, the 1960 OBC Standards Manual. Specific suggestions for improvement of the present standards and for additional standards will be most welcome.

COMMITTEES

Engineering Coordination Committee

W. C. Conover-Outboard Marine Corporation
David Beach-Oufboard Marine Corporation
Richard Heidner-Wesf 8enc/ Aluminum Company
Douglas Wiltse-Aero-Craft Boats
Robert Wold-Cadillac Marine & Boat Company
S. J. Fraenkel-Standard Railway Equipment Mfg. Co.
J. E. Olney-Tee Nee Trailer Company
Cort Gravengood-Attwood Brass Works, Inc.

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Edgar R. Jordan-Oliver Outboard Motors
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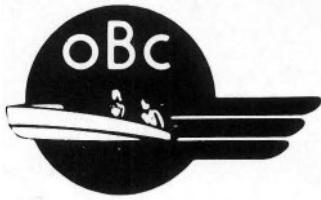
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William Murphy - Perkins Marine Lamp & Hardware
Harwood Shepard - Aluminum Marine Hardware Co.
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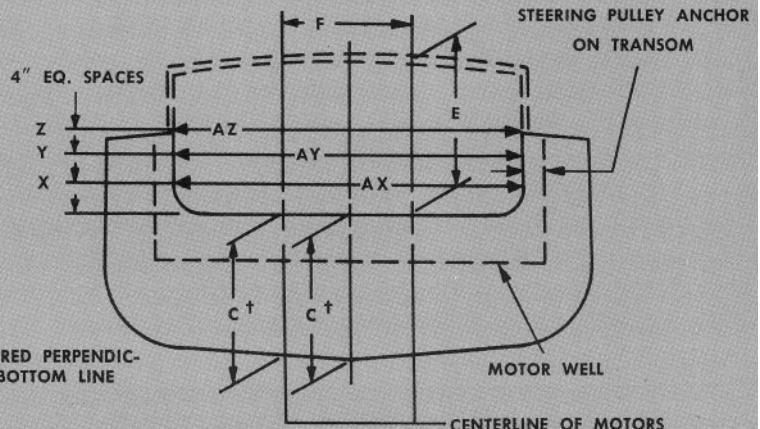
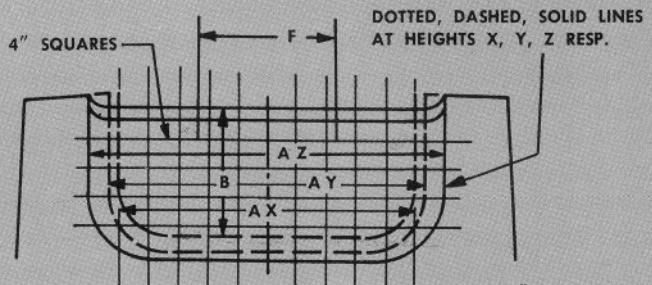
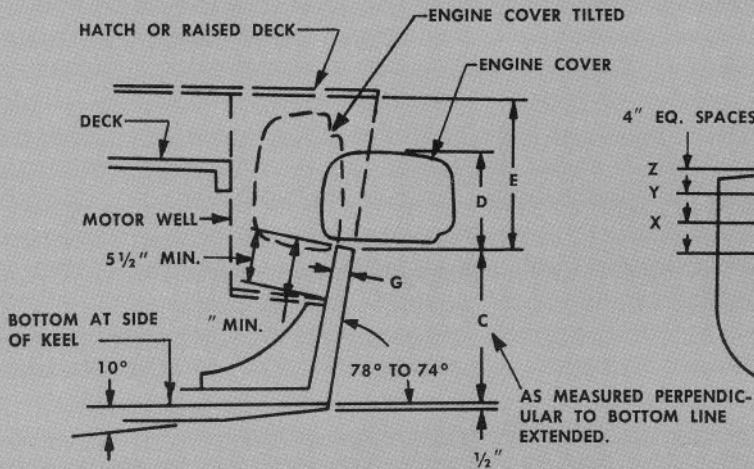
BOAT STANDARDS RECOMMENDED PRACTICE

TRANSOM DIMENSIONS

A 20" transom height (Dimension C) should be used on any boat having an OBC rating of 30 HP or over. A boat having a rating of 30 HP or over may be built with a 15" transom if fitted with a self-bailing well having a 1" drain hole at each end of the well.

As a safety measure, when the inboard section of the motor cutout is formed by the back of a seat, and it is possible that a passenger's arm may be caught between the after deck and the motor in the event of a sudden tilt-up of the motor, add 3" to Dimension B.

^tMeasured perpendicular to extended bottom lines



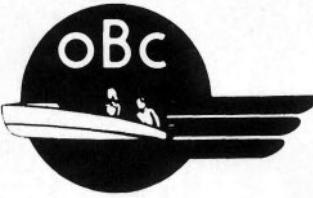
H.P. PER MOTOR	NO. OF MOTORS	CUTOUT WIDTH A*			CUTOUT LENGTH B			C AT CENTER OF MOTOR	D CLEAR	E TILT	F**	G MIN. MAX.
		X HEIGHT	Y HEIGHT	Z	X HEIGHT	Y HEIGHT	Z HEIGHT					
UNDER 12 H.P.	1	21"	23"	27"	21"	21"	21"	15" OR 20"	17"	20"	22	138" 13 1/4"
	2	43"	45"	49"								
12 H.P. THRU 40 H.P.	1	28"	34"	34"	21"	21"	21"	15" OR 20"	21"	29"	— 22	1 38" 13 1/4"
	2	50"	56"	58"								
OVER 40 H.P.	1	28"	35"	36"	251/2"	251/2"	28"	15" OR 20"	261/2"	321/2,	26	11 1/2" 21 1/4"
	2	54"	61"	62"								

* FOR 45° STEERING

t WHERE BOATS HAVING TRANSOMS CUT FOR TWIN ENGINES MAY BE USED WITH ONE LARGE ENGINE, AND THE BOTTOM AT THE TRANSOM HAS CONSIDERABLE VEE OR DEADRISE, PROVISION SHOULD BE MADE FOR READILY REDUCING THE TRANSOM HEIGHT AT THE CENTERLINE TO 15" OR 20" WHEN A SINGLE ENGINE IS FITTED.

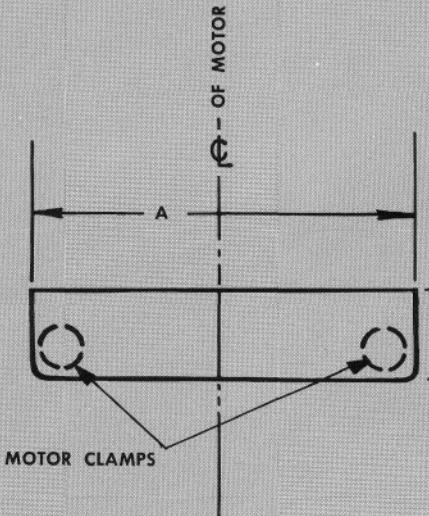
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BOAT ENGINEERING COMMITTEE

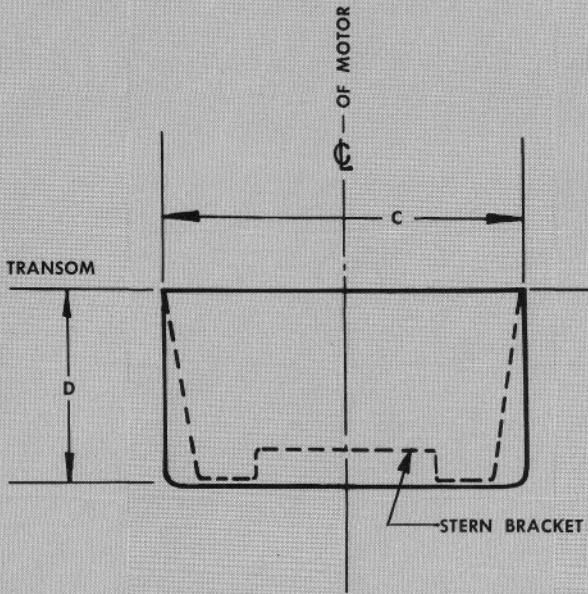


BOAT STANDARDS
RECOMMENDED PRACTICE

MOTOR MOUNTING AREAS



FWD FACE OF TRANSOM LOOKING AFT



AFT FACE OF TRANSOM LOOKING FWD

NOT DRAWN TO SCALE

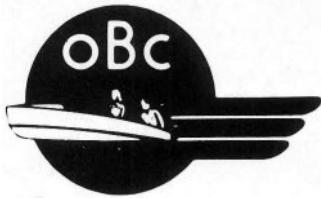
O.B.C. H.P. RATING 1	A	B	C	D
UNDER 12	8 1/2		8 1/4	
12 THRU 40	15 1/4	5 1	14 1/2	
OVER 40	10 1/8		12 1/2	11 1/2

On metal and plastic boats, where wood, rubber or soft plastic areas are provided on the transom to which motors can be securely clamped, the dimensions of the clamping area shall be no less than those shown in the above table for the maximum HP motor for which the boat is rated. For twin motor installations, where the motors

are located as outlined on the Transom Dimension sheet (see page 5) the two areas required may be made continuous at the discretion of the builder. Attention is directed to the maximum transom thickness dimension, Fig. G on page 5, which will include the thickness of the Motor Mounting Area material where such material is used.

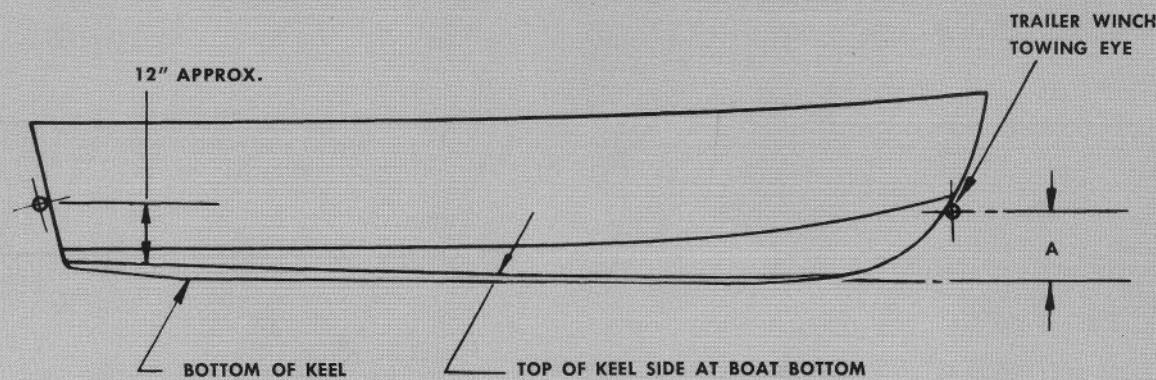
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BOAT ENGINEERING COMMITTEE



**BOAT STANDARDS
RECOMMENDED PRACTICE**

KEEL AND TRAILER TIES



Boats shall be fitted with a centerline keel which shall be in accordance with the recommendations shown on the Transom Dimension Sheet (see page 5) and which shall not be less than 34" across the bottom face. The bottom faces shall be rounded to minimize damage to the rubber rollers of a trailer.

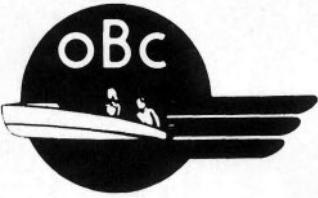
To facilitate loading the boat on its trailer, the keel shall not be less than 1" in depth where the deadrise of the boat bottom is less than 15 degrees. As shown above, the location of the trailer winch

towing bow eye shall be established with reference to the keel line extended. For boats of 16' and under, Dimension A shall not exceed 16", and for boats over 16', shall not exceed 20".

The bow eye shall be of the size specified on the Minimum Deck Hardware sheet (see page 30) and shall be secured perpendicular to the stem to suit the construction method and material of the craft. The strength capacity of the bow eye as installed shall not be less than that required by the Bow Eye Specification Sheet (see page 31).

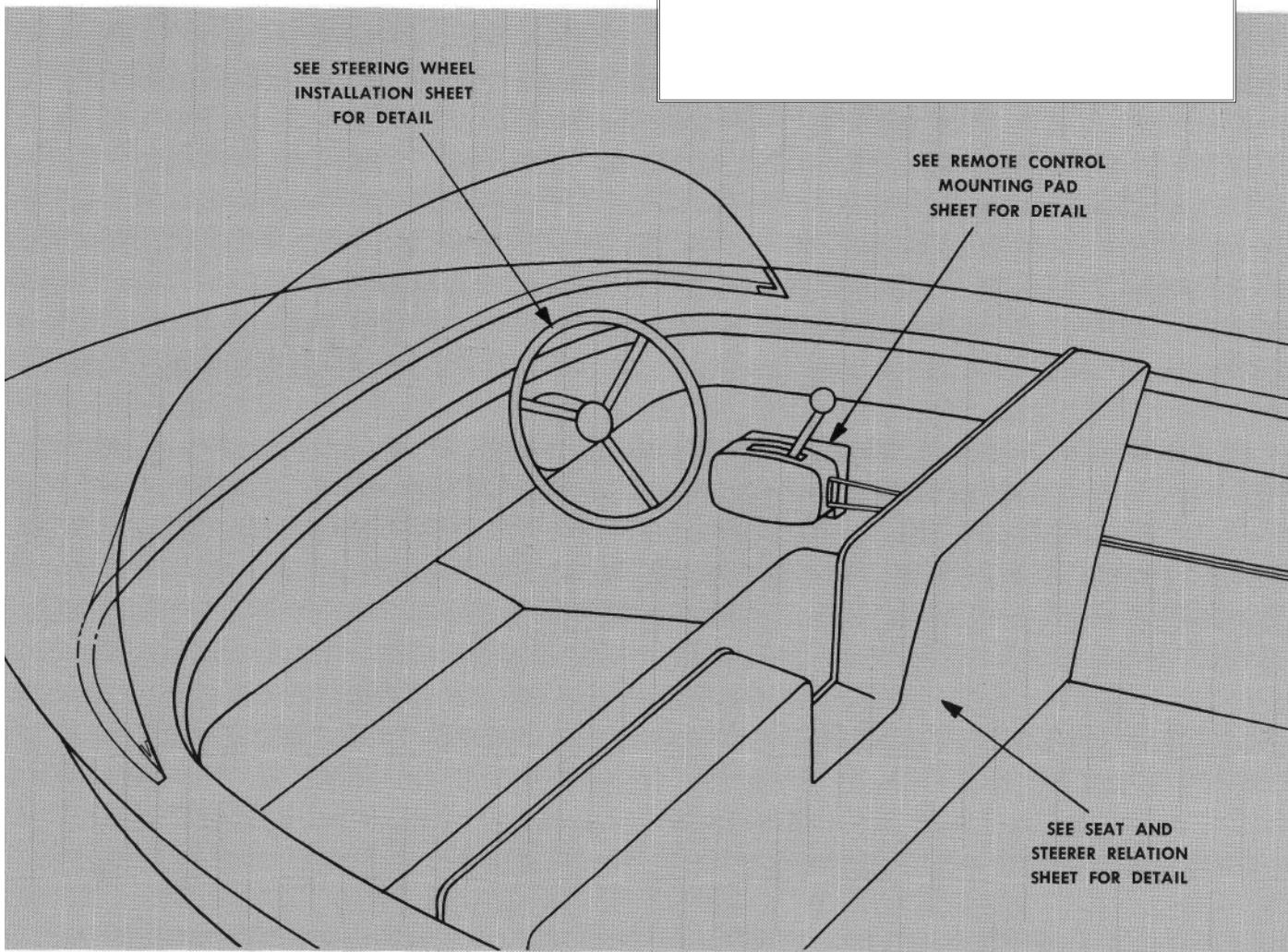
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BOAT STANDARDS
RECOMMENDED PRACTICE

COCKPIT ARRANGEMENT



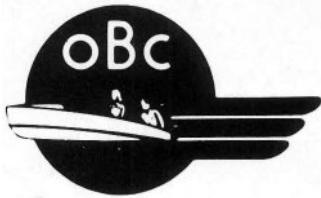
On boats where the OBC rated horsepower exceeds 25, the builder shall make provision for the installation of wheel steering and remote engine controls.

Because of the legal liabilities imposed on the oper-

ator by the "Rules of the Road" pertaining to collision and right-of-way, it is recommended that steering be located forward and on the starboard side to provide the best visibility over the "danger angle," from ahead to 22 degrees aft of abeam to starboard.

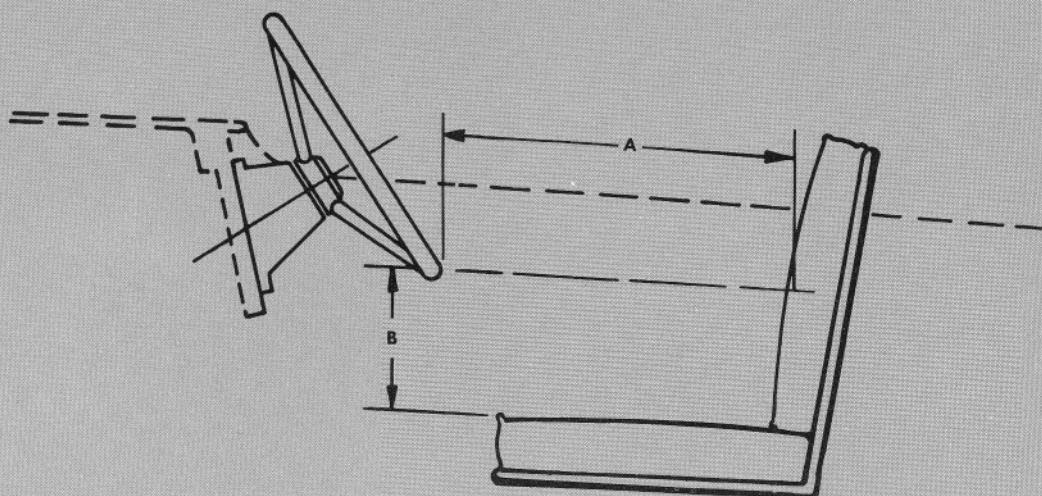
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BOAT STANDARDS
RECOMMENDED PRACTICE

SEAT AND STEERER RELATIONS



NOT DRAWN TO SCALE

On boats where steerers are not factory installed equipment, seats and dash panels shall be so located by the builder that a standard steerer, as defined in the Steering Wheel Dimension Sheet (see page 32), may be fitted to the dash to provide a comfortable craft.

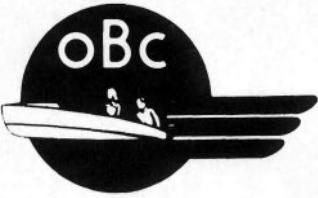
Seats shall be placed relative to the position of a properly installed steerer (of either straight or

20-degree column angle on a vertical or inclined dash) so that the sum of Dimensions A and B shall be approximately 27" to 30". A maximum of 20" for Dimension A is considered appropriate.

Dimensions are given from the lower edge of the steerer rim to the seat back and top of fixed upholstered seats or life preserver cushions.

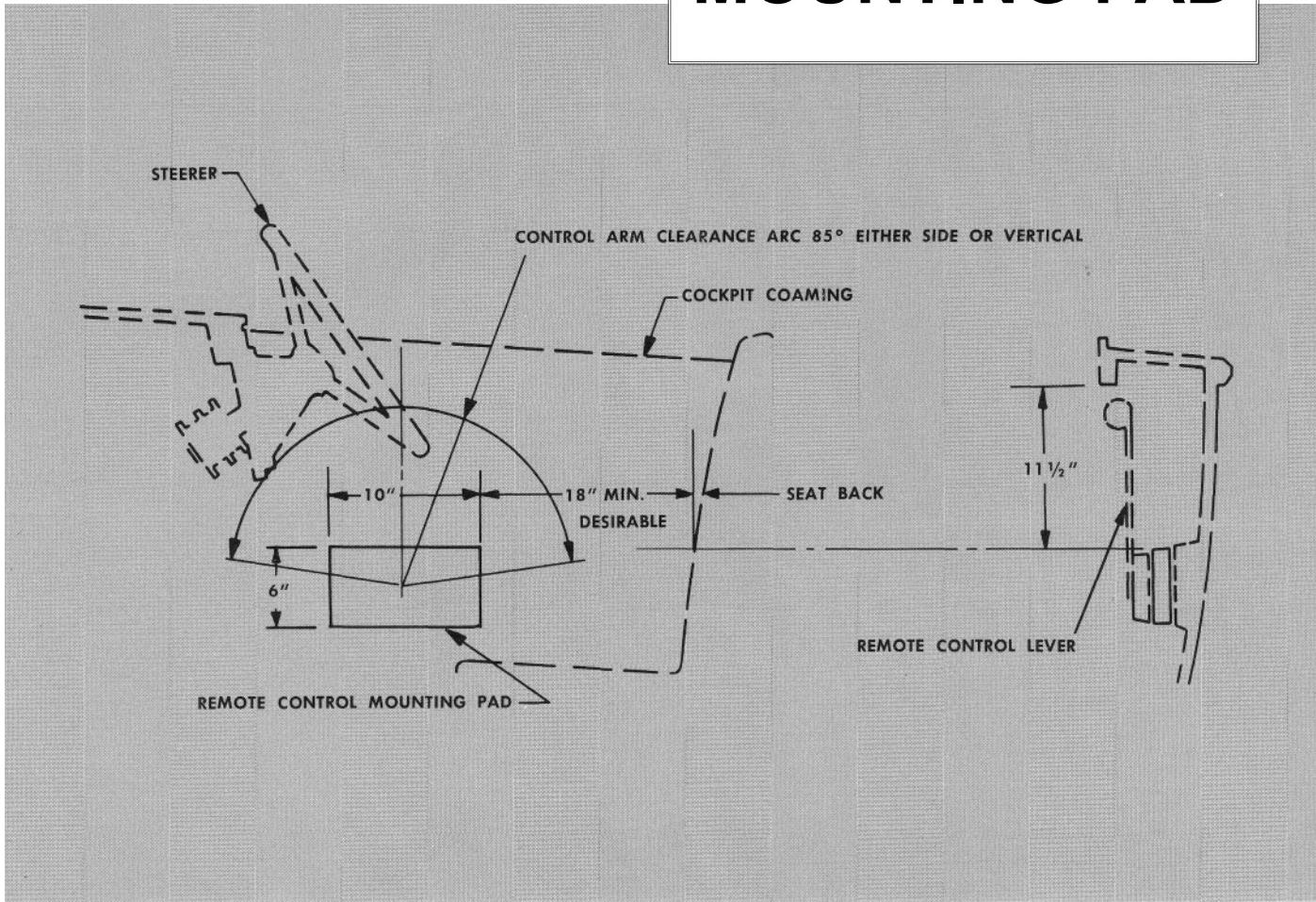
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BOAT STANDARDS
RECOMMENDED PRACTICE

REMOTE CONTROLS MOUNTING PAD



All boats fitted for the installation of remote control steering and motors with remote controls shall be fitted with a remote control mounting pad.

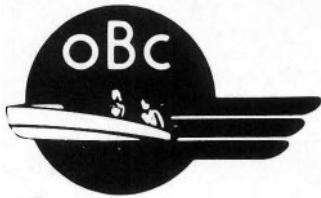
The mounting pad shall be 6" by 10" in size and shall be mounted so that the pad face shall be substantially vertical and parallel to the centerline. It shall be so located that there is 11 $\frac{1}{2}$ " vertical clearance between the top of the pad and the

underside of any overhanging structure. Its horizontal location shall permit full range of control without interference with dash or coaming structure and without arm or elbow interference with the seats or other structure.

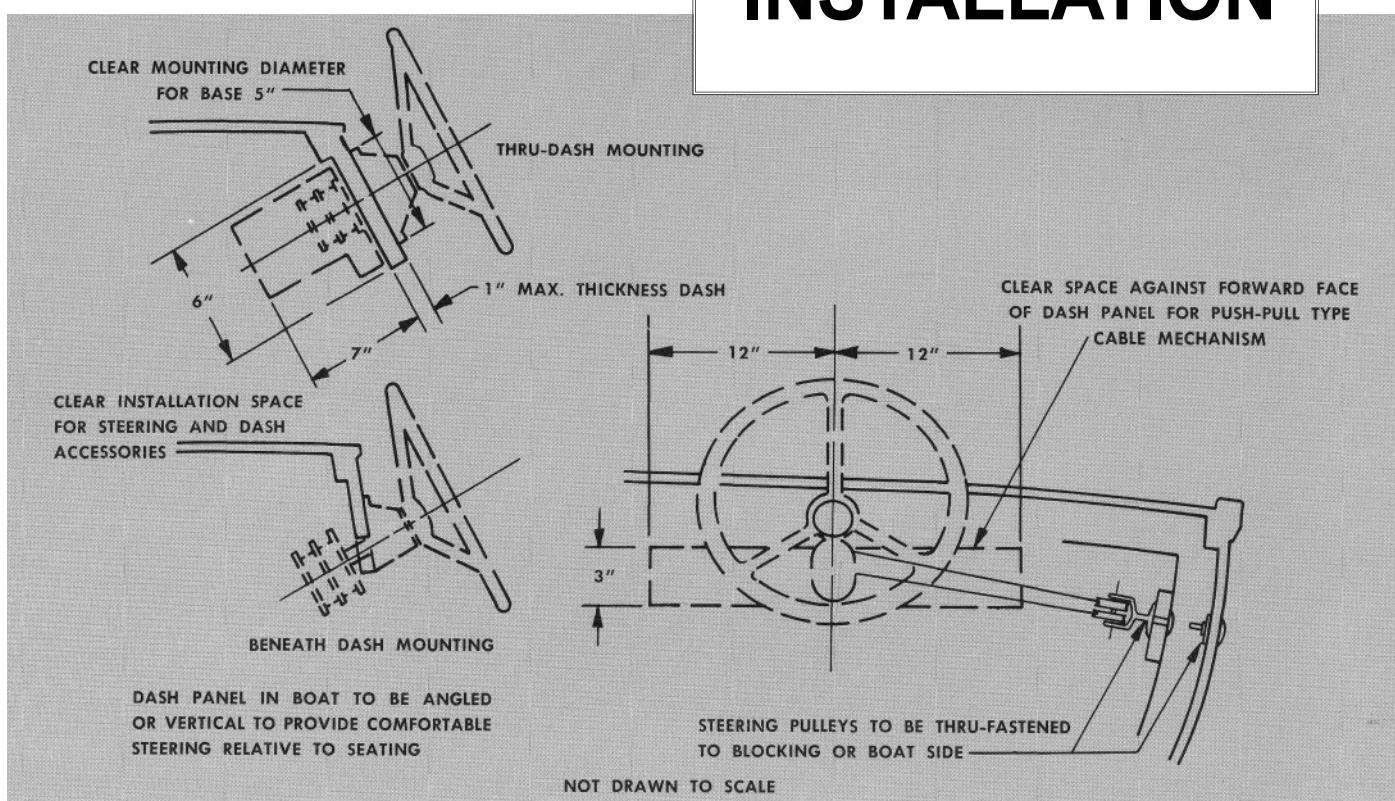
The location of the remote control mounting pad shall be such that the control leads therefrom have unobstructed access to the motor.

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**BOAT STANDARDS
RECOMMENDED PRACTICE**

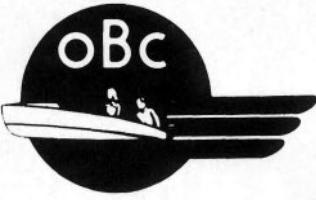


Provision shall be made for the installation of remote steering controls on boats where the OBC rated h.p. exceeds 25. Where steering is not factory installed, the builder shall provide for the installation of the several forms of that equipment by the dealer or user. Clearances shall be provided, as dimensioned above, behind a dash panel, which shall not exceed 1" in thickness, for the installation of a standard wheel as defined in the Steering Wheel Dimensions sheet (see page 32). The dash panel shall be positioned so that one of the standard wheel mounting angles will provide ample driver clearance as on the Seat

and Steerer Relation sheet (see page 9). Where the location or existence of side frames or other structure makes the fitting of steering cable pulleys on the planking or shell inadvisable, the builder shall fit blocking, or otherwise provide for the mounting of steering cable pulleys, which shall be in accordance with the Steering System Pulleys sheet (see page 33). The recommended blocking is to be 6" by 8" mounted just below the dash, parallel to sheer. The builder shall give due consideration to the location of seats, bulkheads and other structure to insure direct leads of steering cables to the motor.

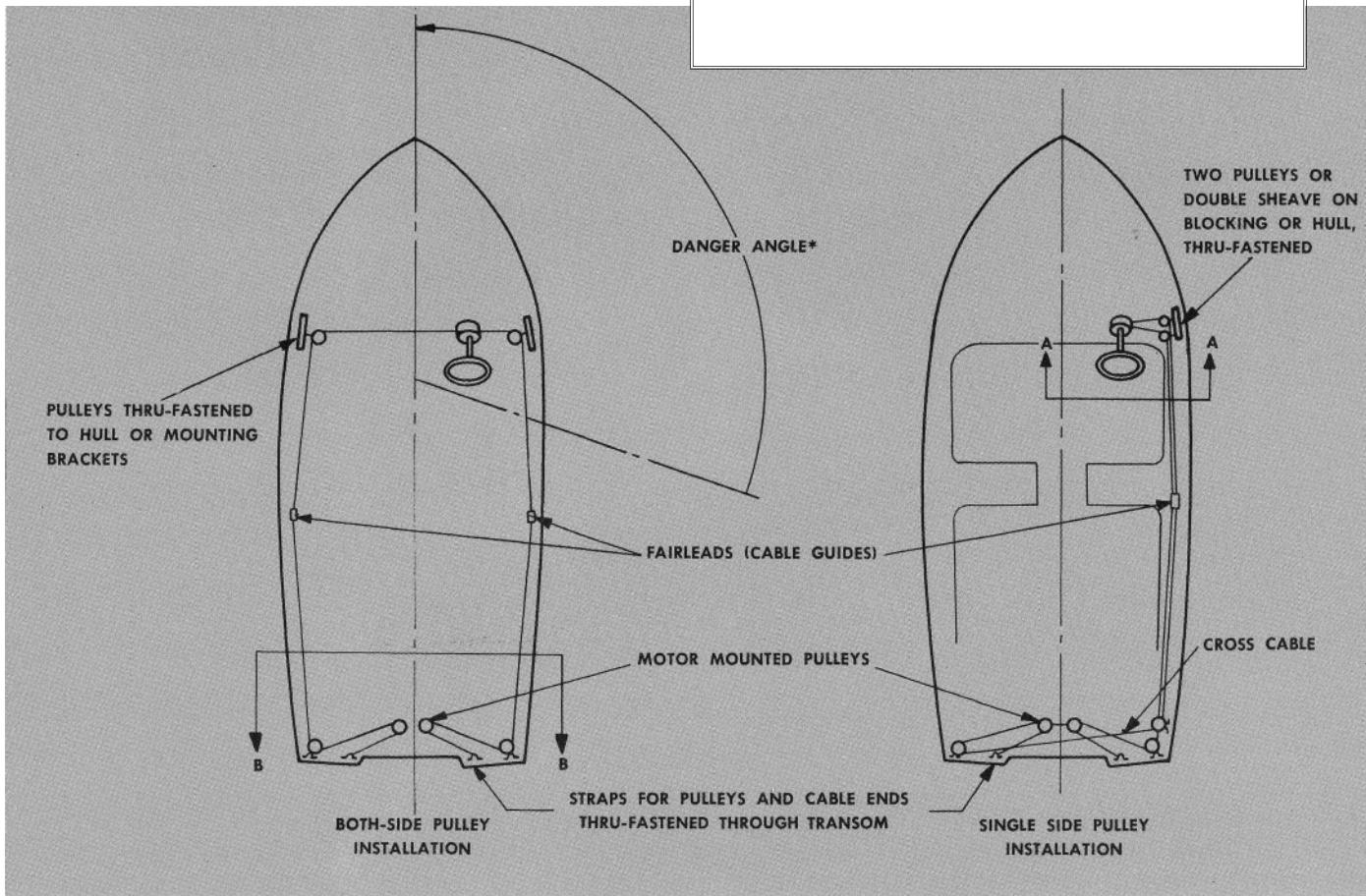
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BOAT STANDARDS
RECOMMENDED PRACTICE

STEERING CABLE INSTALLATION



**Rules of the Road" require that the boat give way to other craft approaching within "Danger Angle."

On boats where steering is not factory installed, the builder shall make provision for the mounting of such pulleys, fairleads, and end fittings as are indicated on the Steering Wheel Installation sheet (see page 11) and Transom Steering Installation sheet (see page 13).

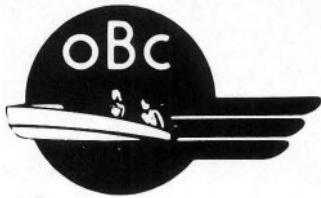
To insure maximum cable life, all pulleys should be 2" score diameter, as shown on Steering Sys-

tem Pulleys sheet (see page 33), and fairleads (cable guides) shall be located along the sides to reduce the angular bend in the cables at the Fairleads as much as possible.

All pulleys and cable-end straps shall be thru-fastened.

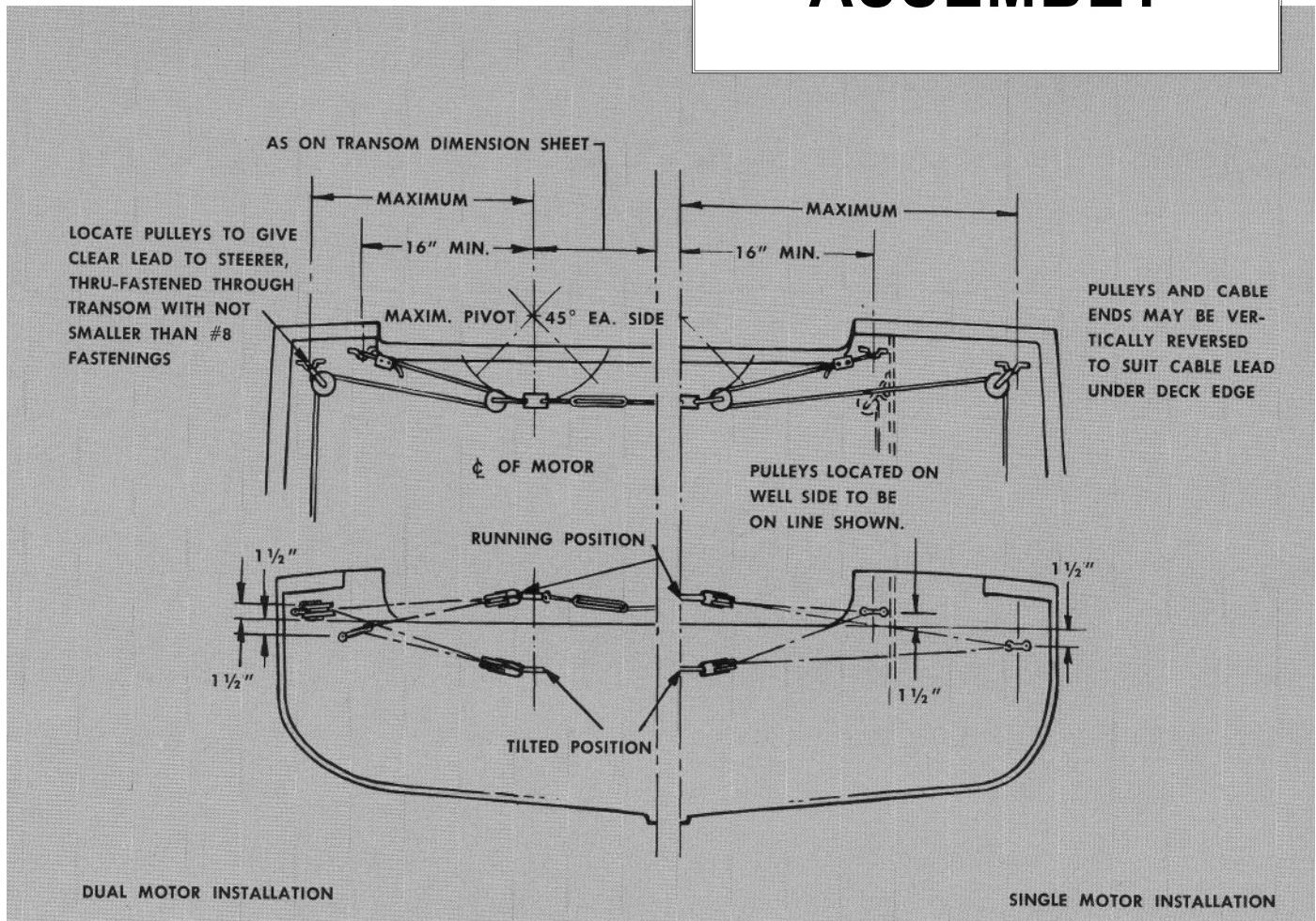
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MARINE FITTINGS ENGINEERING COMMITTEE



BOAT STANDARDS
RECOMMENDED PRACTICE

TRANSOM STEERING ASSEMBLY



On boats where steering rigging is not factory installed, the builder shall make provision for the mounting of such pulleys and end fittings as shall be required by good practice.

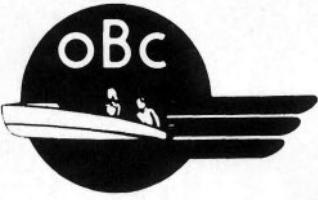
In general, pulleys shall be located as far outboard as possible, as shall be the end fittings for the cable clamps. To prevent undue tension in the cables as the motor (s) is pivoted or tilted, attach-

ment straps should be located, with reference to the transom top as shown.

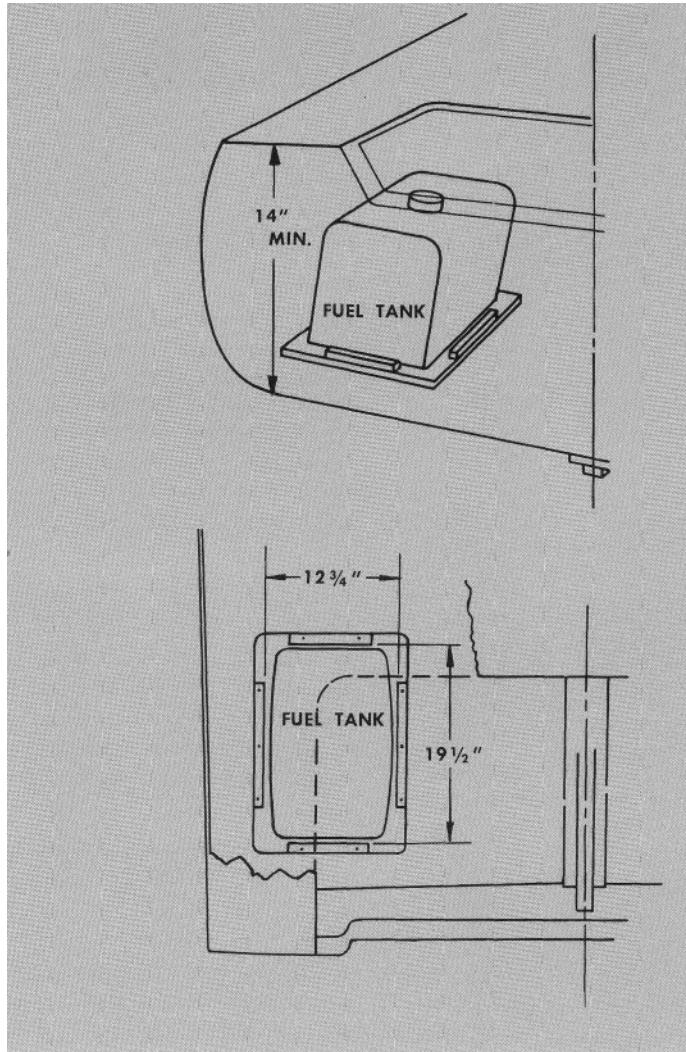
Where deck structure or bulkheads are installed by the builder, adequate provision shall be made for the fitting of end attachments in such position that cables and pulleys shall operate, in all conditions, free of the structure.

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BOAT ENGINEERING COMMITTEE
MARINE FITTINGS ENGINEERING COMMITTEE



BOAT STANDARDS RECOMMENDED PRACTICE



Tanks shall be located port and/or starboard to suit. The minimum vertical clearance above tank bottom to fixed deck or seat structure shall be not less than 14" to facilitate removal of gas tank from boat for refueling.

PORTABLE FUEL TANK

ALL PORTABLE TANKS SHALL CARRY A LABEL, "CAUTION. REMOVE TANK FROM BOAT WHEN FILLING TO REDUCE FIRE HAZARD."

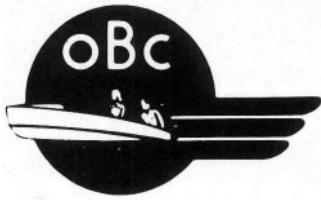
ANY TANK WITH THE CAPACITY OF OVER 7 GALLONS SHALL NOT BE CONSIDERED "PORTABLE."

BUILT-IN FUEL TANKS IN OUTBOARD BOATS SHOULD BE FABRICATED AND INSTALLED IN ACCORDANCE WITH THE CODE OF THE NATIONAL FIRE PROTECTION ASSOCIATION (SEE FIRE PROTECTION STANDARDS SECTION).

Dimensions show minimum clear area required for single tank stowage. Where tank stowage consists of cleats only on cockpit flooring or on a substantially horizontal surface, those cleats should be not less than $\frac{7}{8}$ " in height.

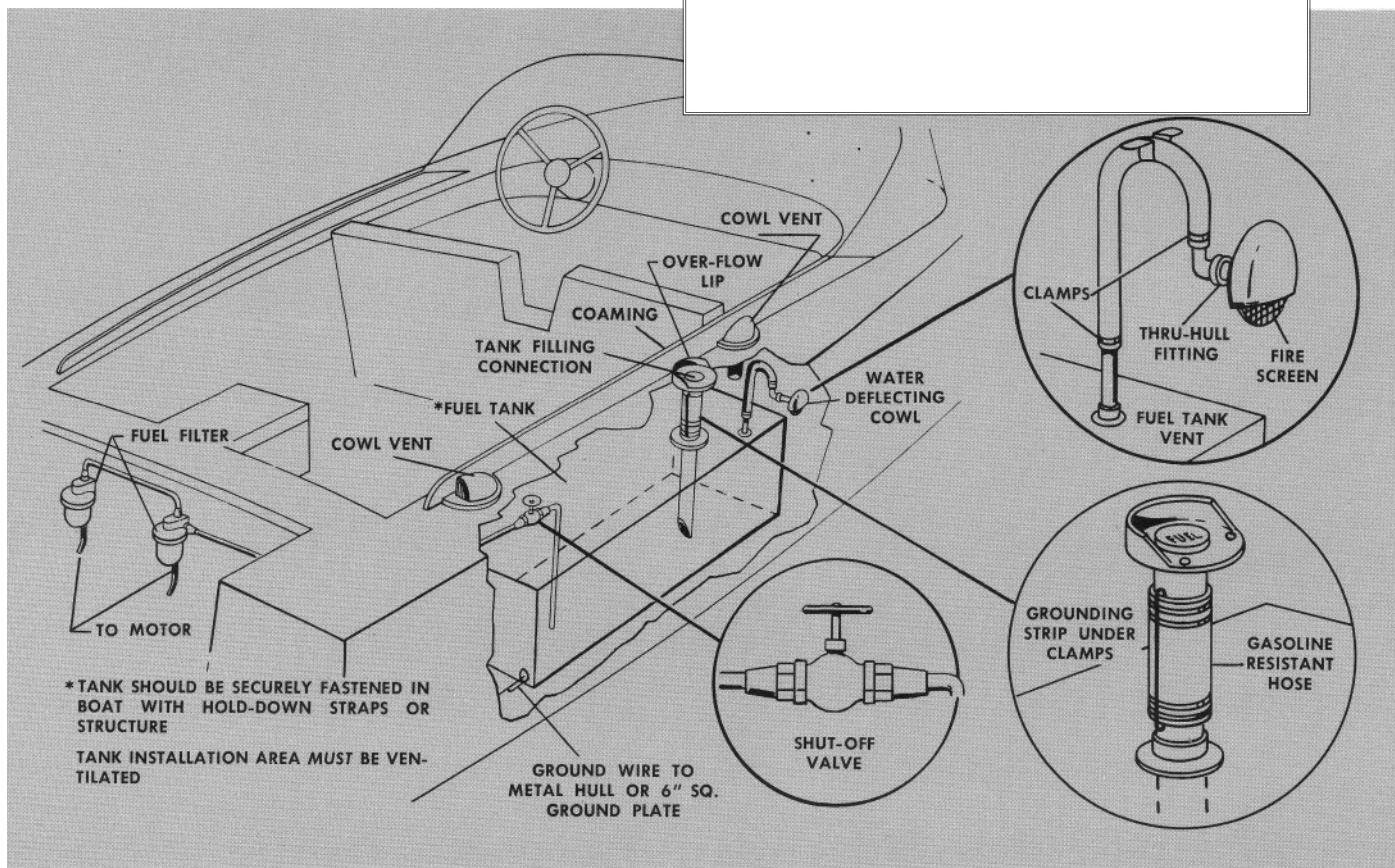
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BOAT STANDARDS
RECOMMENDED PRACTICE

PERMANENT FUEL TANK.



Built-in fuel tanks for outboard powered boats are subject to the same requirements as those for inboard powered boats under the Motor Boat Act of 1940.

Illustrated above is a typical permanent tank installation in a larger outboard powered boat. Single or dual tank installation locations vary, depending on weight and other arrangement considerations. Installation based on the above illustrated information greatly reduces the danger of explosion and fire.

Deck plates are located outboard of cockpit coamings so fuel spillage flows overboard. On runabouts, a deep lip on the inboard side of deck plates prevents fuel spillage from flowing into boat. All connections, deck plates and tanks should be grounded to the metal hull or to a ground plate, minimum size 6 inches square, on outside of plastic or wooden hulls below the water-line.

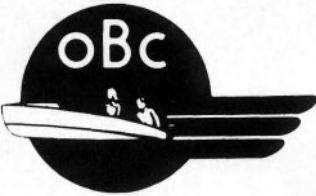
Fuel vent lines permit the discharge of gasoline vapor during filling, temperature changes, or evaporation, and should lead overboard, as high as possible, through the hullside. The through-hull fitting should be provided with a fire screen flame arrester to prevent flashback from any possible source of ignition.

All fuel lines should be made up with a minimum of connections, flare type fittings are recommended. A shut-off valve, packless type or similar, should be connected to the fuel line at tank outlet. Tank outlet pipe should extend through top of tank to the lowest part of the tank in the normal trim condition.

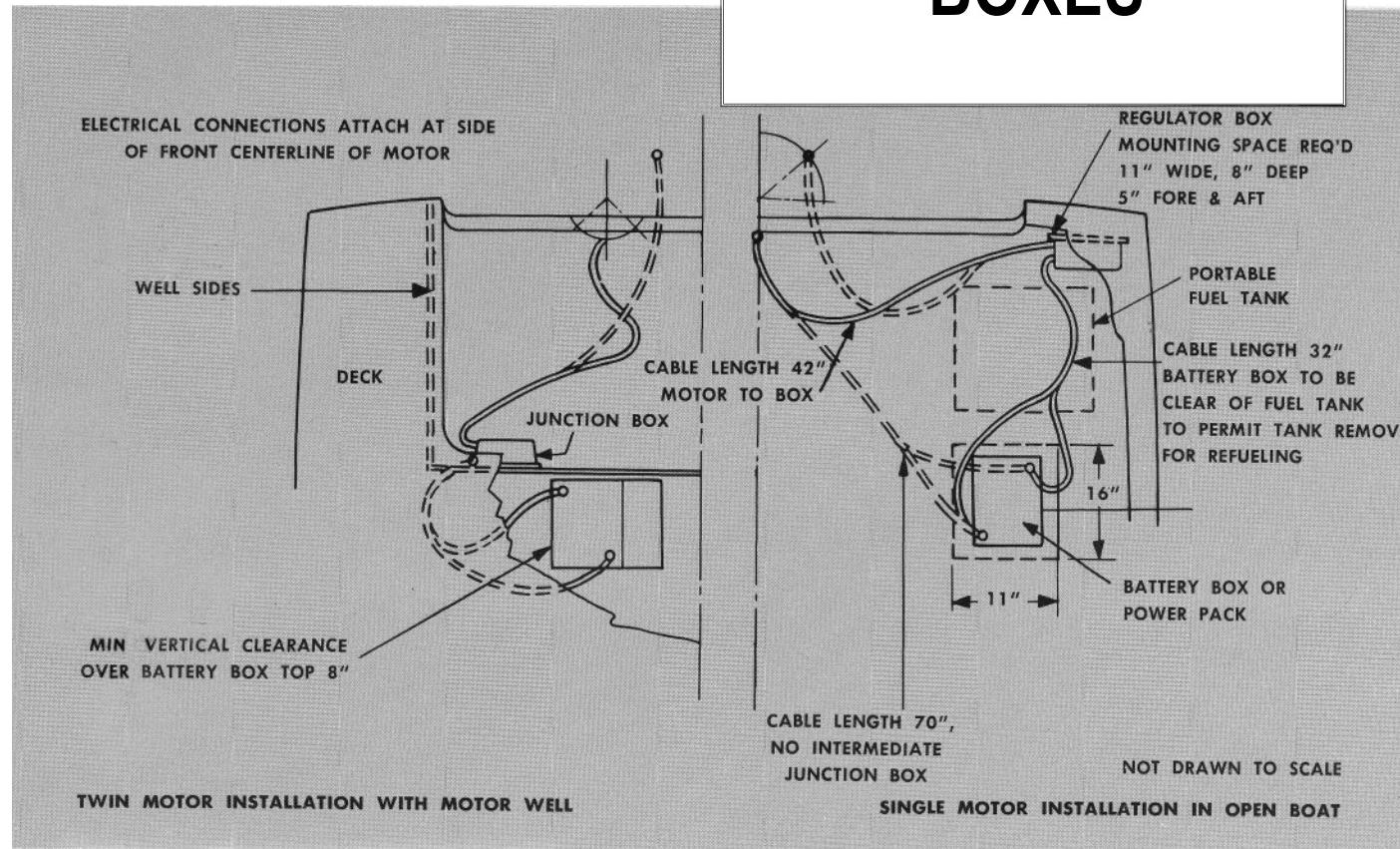
Two cowl ventilators or their equivalent *must* be used to thoroughly ventilate closed space where fuel tanks are installed as beneath flooring, inside bulkheads, etc. The danger from confined gasoline vapors cannot be over emphasized.

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BOAT ENGINEERING COMMITTEE



BOAT STANDARDS RECOMMENDED PRACTICE



Provision shall be made for the mounting and stowage of equipment associated with electric starting on boats where available motors have or may have such starting.

The builder shall provide a minimum area of not less than 11" by 16", or multiples thereof, for the stowage and securing of batteries, battery cases or charging units. This area shall lay within the arcs described by the lengths of the electrical cables herein specified.

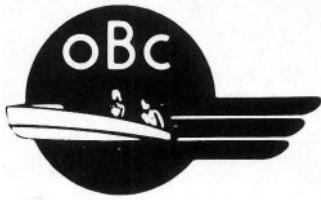
Clearance above the battery, to the underside of any fixed structure shall not be less than 8" to permit the use of an electrolyte hydrometer. The battery mounting base shall be of size and thickness

adequate to retain fastenings for the battery, which may be clamps, straps or ties.

Provision shall be made for the junction box-regulator. A mounting bracket or space 8" by 11", substantially vertical, shall be located with a radius of 36" from the centerline of the motor at the forward face of the transom. This area shall be protected from spray or splashing water. This mounting area shall be further located so that battery cables of length equal to 32" may be connected to the battery from the junction box. To accommodate motors where no intermediate junction box is required, the battery area shall be further located so that cables of standard length equal to 70" may be connected from battery to motor.

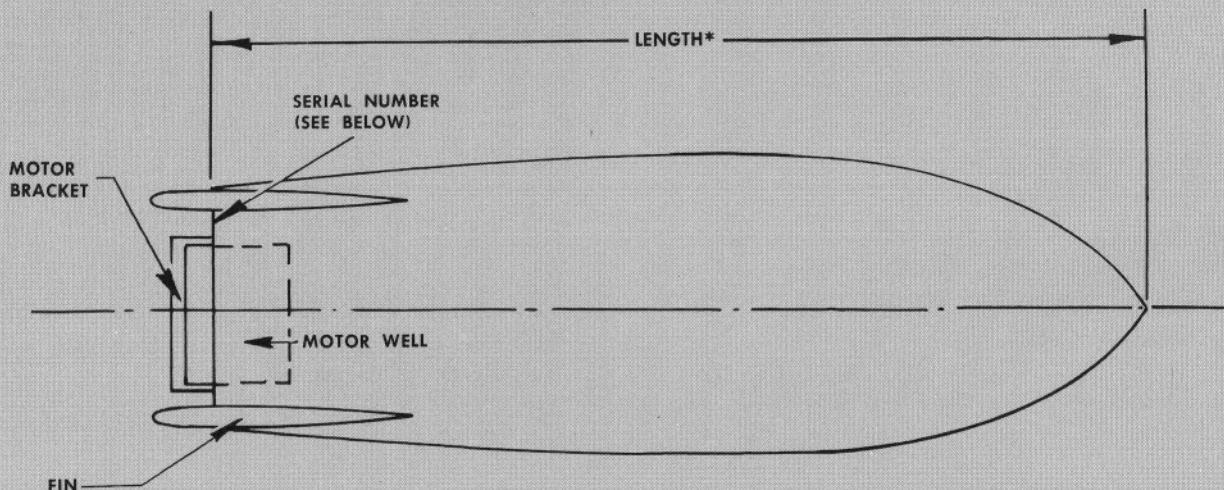
APPROVED

MOTOR ENGINEERING COMMITTEE
BOAT ENGINEERING COMMITTEE



BOAT STANDARDS
RECOMMENDED PRACTICE

ADVERTISED BOAT LENGTH



*IF LENGTH EXCEEDS 16'-0" AND BOAT IS OPERATED ON FEDERAL WATERWAYS, THE BOAT MUST BE REGISTERED WITH THE COAST GUARD UNDER THE NUMBERING ACT OF JUNE 7, 1918. FOR ADDRESS OF LOCAL COAST GUARD OFFICE AND NUMBER REGISTRATION APPLICATIONS, APPLY TO U. S. COAST GUARD HEADQUARTERS, WASHINGTON, D.C. WHERE THE MOTOR IS BOLTED RATHER THAN CLAMPED TO THE TRANSOM OF A BOAT UNDER 16' IN LENGTH, REGISTRATION ALSO IS REQUIRED.

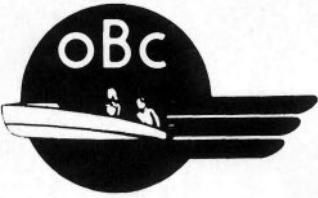
Boat manufacturers, in stating the length of a boat, shall use the actual hull length in feet and inches as measured from the stem face to transom outside its highest point on a straight line parallel to keel,

excluding any extending structures such as outboard brackets, fins, etc.

A serial number should be affixed to each boat manufactured, stamped on or near the transom.

APPROVED

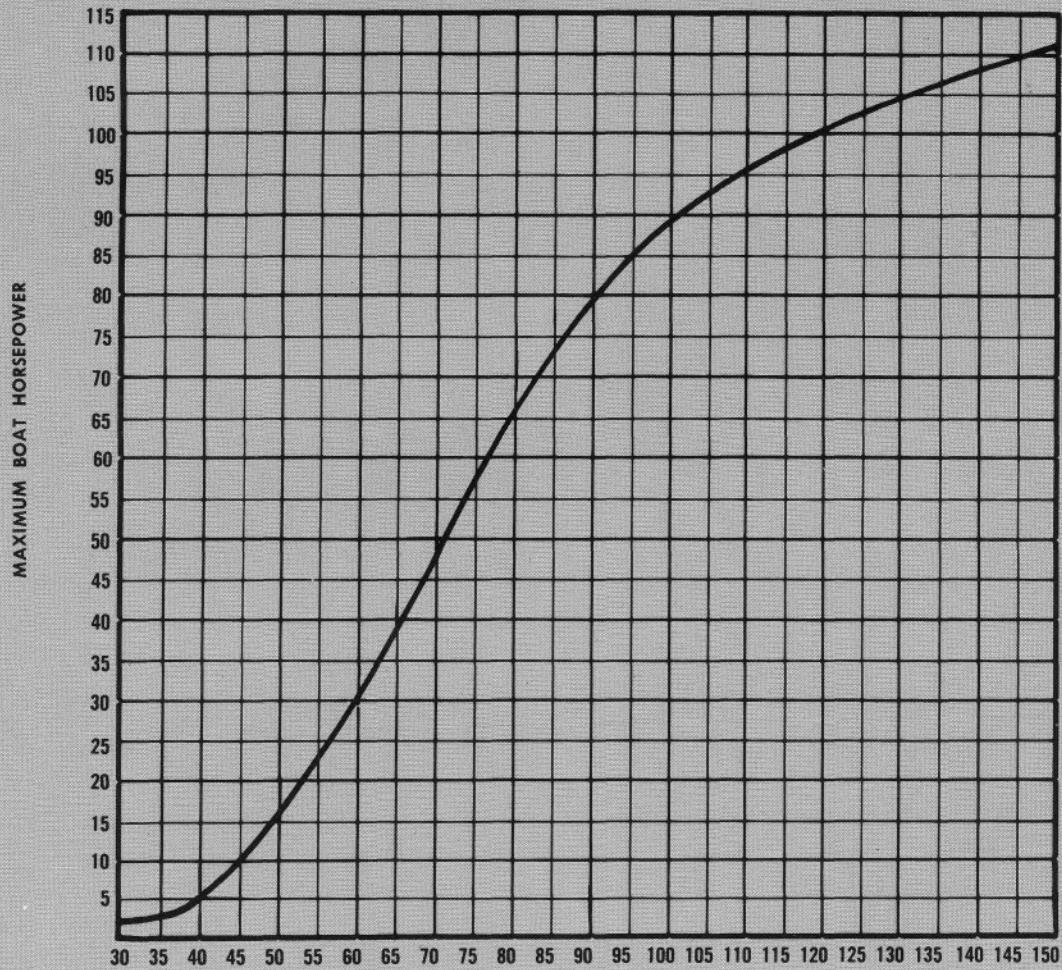
BOAT ENGINEERING COMMITTEE



BOAT STANDARDS
RECOMMENDED PRACTICE

BOAT HORSEPOWER CAPACITY

OBC BOAT HORSEPOWER CURVE



Product: Overall length in feet x overall stern width in feet.

APPROVED

BOAT ENGINEERING COMMITTEE



BOAT STANDARDS RECOMMENDED PRACTICE

BOAT HORSEPOWER CAPACITY

(CONTINUED)

HORSEPOWER CAPACITY

Boats shall be recommended by the builder for use with a motor not exceeding in size the maximum horsepower capacity determined by the application of the following OBC Maximum Boat Horsepower Formula.

In the interests of safe family boating, the Boat Engineering Committee in 1948 adopted the OBC Maximum Boat Horsepower Formula. This formula provides for the determination of the maximum horsepower (either a single engine or twin engines) for a particular boat to insure safe family boating.

To test the validity and reliability of the formula, the Boat Engineering Committee tested boat shapes and sizes at Winona Lake, Warsaw, Indiana in the spring of 1957. As a result of these tests, the Horsepower Curve has been modified by reducing the maximum horsepowers for small rowboats and larger outboards. Further tests are planned to improve the formula.

Although the use of the OBCCapacity Plate (on which OBC rates horsepower and weight capac-

ity) and the display of the OBC insignia in advertising is naturally limited^{to} members of the Outboard Boat Manufacturers Association (an affiliate of OBC), boat builders are encouraged to use the horsepower formula in determining their recommended maximum horsepower for their boats.

Procedure for determining maximum horsepower

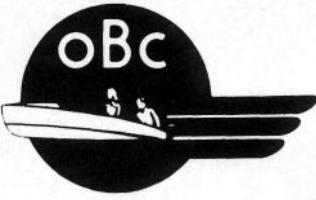
STEP 1. Multiply overall boat length (see Advertized Hull Length sheet, page 17) by overall stern width (widest part of stern).

Length _____ \times Stern width _____ = _____
nearest whole number

STEP 2. On the horizontal axis of the Boat Horsepower Curve, locate the point that corresponds to the product arrived at in Step 1. Follow vertical line up to where it meets the curve. Read across to the vertical axis to find the equivalent point on the axis. Then take the printed number immediately above this point as the Maximum Horsepower for the boat. (Example: If the point on the vertical axis is 32, the printed number above is 35.)

APPROVED

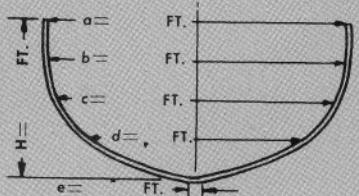
BOAT ENGINEERING COMMITTEE



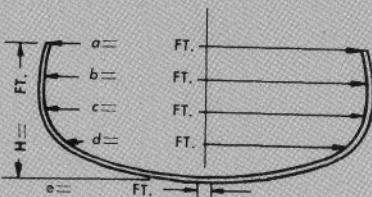
BOAT STANDARDS RECOMMENDED PRACTICE

BOAT WEIGHT CAPACITY

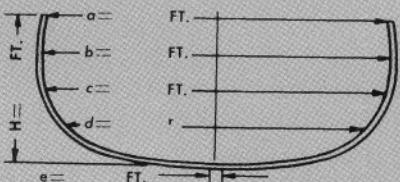
BOAT INTERIOR DIMENSIONS



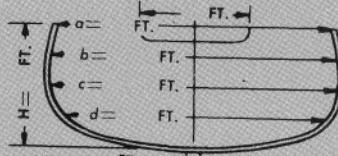
(A) QUARTER LENGTH FORWARD



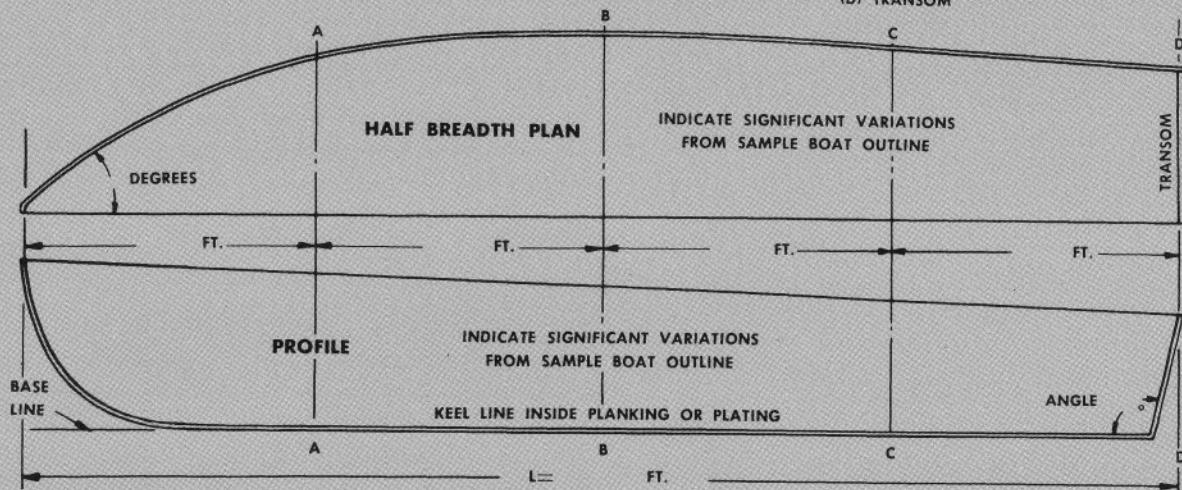
(C) QUARTER LENGTH AFT



(B) AMIDSHIPS



(D) TRANSOM



LENGTH FROM STEM INSIDE PLANKING TO STERN INSIDE HIGHEST POINT OF TRANSOM ON A STRAIGHT LINE PARALLEL TO KEEL.

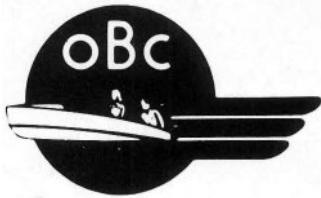
TRANSVERSE SECTIONS (A, B and C) are taken at three points obtained by dividing length (L) into four equal parts.

HORIZONTAL BREADTHS (a, b, c, d, and e) are secured by measuring at upper and lower points of the height (H) and at three points selected by dividing (H) into four equal parts.

MEASUREMENTS are taken inside planking or plating and recorded in feet with decimal equivalents for inches and eighths.

APPROVED

BOAT ENGINEERING COMMITTEE



BOAT STANDARDS RECOMMENDED PRACTICE

BOAT WEIGHT CAPACITY

Boats shall be recommended by the builder for use with a load not exceeding 12.5 pounds per cubic foot of internal volume, calculated in accordance with the OBC Maximum Weight Capacity Formula, which follows.

Background

To insure safe boating, the Boat Engineering Committee in 1949 developed the OBC Maximum Weight Capacity Formula for outboard boats. The formula provides for the determination of the maximum weight of passengers, motor and gear which can be safely carried. It allows 12 cubic feet per passenger. With the weight of the average passenger estimated at 150 lbs., the formula permits 12.5 lbs. of load per cubic foot. To test the validity and reliability of the formula, the Boat Engineering Committee made tests on Lake Winnebago at Oshkosh, Wisconsin, in 1954. Boats ranging from 12 feet to 16 feet in length were tested.

Although use of the OBC Capacity Plate (on which OBC rates horsepower and weight capacity) and display of the OBC insignia in advertising is naturally limited to members of the Outboard Boat Manufacturers Association (an affiliate of OBC), boat builders are encouraged to use the weight capacity formula in determining the recommended weight capacity for their boats.

Procedure for Determining Weight Capacity

The formula for determining the weight capacity of a boat is reproduced on page 22, and is followed by a work sheet with appropriate blanks. To use the formula, it is necessary only to insert the proper figures in the blanks and perform the indicated mathematical steps.

The figures to be inserted in the blanks are to

BOAT WEIGHT CAPACITY

(CONTINUED)

TABLE I

CONVERSION TABLE
FRACTIONS OF INCHES AND INCHES TO FEET

INCHES	DECIMALS	INCHES	DECIMALS
1/8"	.010'	3"	.250'
14"	.021'	4"	.333'
3/8"	.031'	5"	.417'
12"	.042'	6"	.500'
58"	.052'	7"	.583'
3#	.062'	8"	.667'
	.073'	9"	.750'
1"	.083'	10"	.833'
2"	.167'	11"	.917'

TABLE II

MAXIMUM ALLOWABLE HEIGHT
FOR A TRANSVERSE SECTION

(To be used for computation of square feet in Transverse Sections)

Beam of Section in Feet	Maximum Allowable Height For That Section, Feet
Up to 4.042'	1.583'
4.043' to 4.375'	1.667'
4.376' to 4.709'	1.750'
4.710' to 5.042'	1.833'
5.043' to 5.375'	1.917'
5.376' to 5.709'	2.000'
5.7 10' to 6.042'	2.083'
6.043' to 6.375'	2.167'
6.376' to 6.709'	2.250'
6.710' to 7.042'	2.333'
7.043' to 7.375'	2.417'
7.376' to 7.709'	2.500'

BOAT WEIGHT CAPACITY (Continued)

be taken from the Boat Interior Dimension drawing on page 20, to which the letters under the blank spaces refer. All dimensions must be converted to decimal numbers before insertion in the formula. Table I converts inches and eighths of inches to the decimal equivalents in feet.

Certain maximums have been established for the height of a transverse section, and these heights, to be used for the computation of square feet of a transverse section, are shown in Table II.

STEP 1: Enter the appropriate measurements for a particular section. Compute the square feet for the three transverse sections as specified.

The maximum allowable height (H) is based on *width* (a) for that section on the Interior Dimensions. If the actual height of the section is *less*

than the maximum allowable height, use the *actual height*. If the actual height of the section is *more* than the maximum allowable height, use the *maximum allowable height*.

STEP 2: From Step 1 enter the computed square feet for Sections A, B, and C in the formula.

A—Square Feet for Section A

B—Square Feet for Section B

C—Square Feet for Section C

Take the figure for length (L) from Boat Interior Dimensions drawing.

STEP 3: From Step 2 enter the computed cubic feet of the boat and multiply it by 12.5 as shown in the formula to determine the Maximum Weight Capacity for passengers, motor and gear.

WEIGHT CAPACITY FORMULA WORK SHEET

STEP 1: COMPUTE AREAS OF SECTIONS

$$\text{Formula: Area} = \frac{H}{12} (a + 4b + 2c + 4d + e)$$

Note: For maximum allowable height (H) in any section, check table II in instructions.

Area A—Section Quarter Length Forward:

$$A = \frac{1}{12} (a + 4b + 2c + 4d + e)$$

A = _____ square feet (three decimal places)

Area B—Section Amidships:

$$B = \frac{1}{12} (a + 4b + 2c + 4d + e)$$

B = _____ square feet (three decimal places)

Area C—Section Quarter Length Aft:

$$C = \frac{1}{12} (a + 4b + 2c + 4d + e)$$

C = _____ square feet (three decimal places)

STEP 2: COMPUTE CUBIC CAPACITY

Formula:

$$\text{Cubic Capacity of Hull} = \frac{L}{12} (4A + 2B + 4C)$$

$$\text{Cubic Capacity} = \frac{1}{12} (4A + 2B + 4C)$$

Cubic Capacity = _____ cubic feet (three decimal places)

STEP 3: COMPUTE MAXIMUM WEIGHT CAPACITY

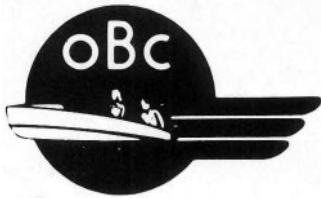
Formula: Maximum Weight Capacity = Cubic Capacity x 12.5 lbs. per cubic ft.

$$\text{Maximum Weight Capacity} = \frac{\text{Cubic Capacity}}{12.5}$$

$$\text{Maximum Weight Capacity} = \frac{\text{Cubic Capacity}}{12.5} \text{ pounds (nearest whole number)}$$

APPROVED

BOAT ENGINEERING COMMITTEE



BOAT STANDARDS RECOMMENDED PRACTICE

OBC BOAT FLOTATION FORMULA

Boats shall be fitted with buoyant material in a quantity to be determined by the OBC Boat Flotation Formula. This formula has been developed and tested by OBC in the interest of providing the consumer with the safest product possible.

By utilizing the flotation formula, a boat manufacturer can determine the quantity of flotation material necessary to provide sufficient buoyancy to keep the craft from sinking when swamped.

The OBC Boat Flotation Formula is:

$$\text{Cubic feet of flotation material needed} = \frac{\text{Pounds of flotation required}}{\text{Buoyancy of flotation material to be used, in pounds per cubic foot}}$$

or $F = \frac{W}{B}$

STEP 1: To determine quantity W (Pounds of Flotation Required) Use this formula:

$$W = W_s + G + .10C \quad (\text{In which})$$

W_s = Submerged weight of the boat alone.

G = Submerged weight of the engine and all other loose gear and equipment and,

C = Dry weight of live load (.10C = submerged weight of live load)

NOTE: To determine quantity W_s^*
(Submerged weight of boat)

Use this formula:

$$W_s = W_h K_1 + W_d K_2 + .69W_e \quad (\text{In which})$$

W_h = Dry weight of hull.

W_d = Dry weight of deck and superstructure.

(Note: W_h and W_d need not be measured separately if both are of the same material)

W_e = Dry weight of factory installed equipment, hardware and accessories.

K_1 = Conversion factor for hull material.
(See Table I, page 24.)

K_2 = Conversion factor for deck and superstructure materials. (See Table I, page 24.)

*The formula for determining W_s may be amplified for greater accuracy by a boat builder using several different materials in the construction of a boat. Parts made of each material are weighed and the weight multiplied by the conversion factor for the material.

BOAT FLOTATION

Sufficient flotation may be defined as that quantity of flotation material which will keep a boat from sinking when it is filled with water and passengers are clinging to it—provided that the aggregate weight of motor, passengers and equipment carried in or attached to the boat does not exceed the boat's maximum weight capacity, as determined by the OBC Maximum Weight Capacity Formula. (See pages 20-22.)

(Note: K_1 and K_2 can be minus quantities if the material floats, which would result in the possibility of $W_h K_1$, $W_d K_2$, or W_s being a minus factor.)

TABLE I
FACTORS FOR CONVERTING VARIOUS BOAT MATERIALS FROM DRY TO SUBMERGED WEIGHT.

MATERIAL	FACTOR
Steel	.88
Aluminum	.63
Fiberglass	.33
Mahogany	-.11
Oak	-.33
Lapstrake (Plywood Strokes)	-.43
Molded Plywood	-.49
Douglas Fir Plywood	-.54
Walnut	-.54
Plylap	-.67
Cedar Strip	-.72
Redwood	-.82
"Royalite"	-1.0

used. The formula given above for W_s will yield an approximate submerged weight, accurate enough in nearly all cases for use in determining the pounds of flotation needed.

BOAT FLOTATION (Continued)

STEP 2: To determine quantity G (Submerged weight of engine and all other loose gear and equipment)

Locate in Table II the maximum horsepower recommended for the boat (See Horsepower Capacity Sheet, pages 18-19). Opposite the maximum horsepower rating is the appropriate estimate dry weight for either a single motor, or for combinations of smaller motors, equaling this range, together with battery or batteries and miscellaneous gear likely to be carried. In the far right hand column, the total of these dry weights has been translated into the submerged weight, G. Use this G factor to determine pounds of flotation required (page 23).

STEP 3: To determine quantity C (Dry weight of live load)

Subtract from the maximum weight capacity of the boat (See Weight Capacity Sheet, pages 20-22) the total *dry weight* figure for motor, battery and loose gear, as shown

maximum recommended horsepower. The result is quantity C — use this C factor, times .10, to determine pounds of flotation required (page 23).

STEP 4: To determine quantity B (Buoyancy of flotation material to be used)

If air chambers are used for flotation, B will be 62.4, which is the weight of a cubic foot of fresh water.

If other flotation materials are used, B will equal 62.4 minus the weight of one cubic foot of the material used, less appropriate allowances for absorption and adsorption characteristics.

STEP 5: To determine quantity F (Cubic feet of flotation material needed)

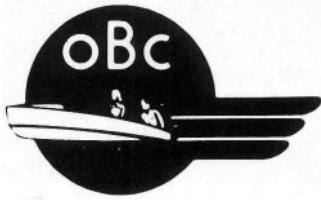
Return to the original formula, $F = \frac{W}{B}$, and substitute the now known W (Pounds of Flotation required, Step 1) and now known B (Buoyancy, Step 4 above). Divide B into W to obtain F.

TABLE II
**WEIGHTS OF ENGINE, RELATED EQUIPMENT, AND LOOSE GEAR FOR VARIOUS
RECOMMENDED HORSEPOWER RATINGS.**

Boat Horsepower Rating	No. of Engines	Dry Wt. Motor	Dry Wt. Battery	Dry Wt. Misc. Gear	Total Dry wt.	Submerged Weight (G)
0-10	1	75	—	50	125	86
11-20	1	95	40	50	185	127
21-40	1	145	40	100	285	196
21-40	2	190	40	100	330	227
41-60	1	250	40	100	390	269
41-60	2	270	40	100	410	282
61-80	1	250	40	125	415	286
61-80	2	290	40	125	455	313
81-100	1	350	40	150	540	372
81-100	2	500	80	150	730	503
101-150	1	400	40	200	640	441
101-150	2	500	80	200	780	538

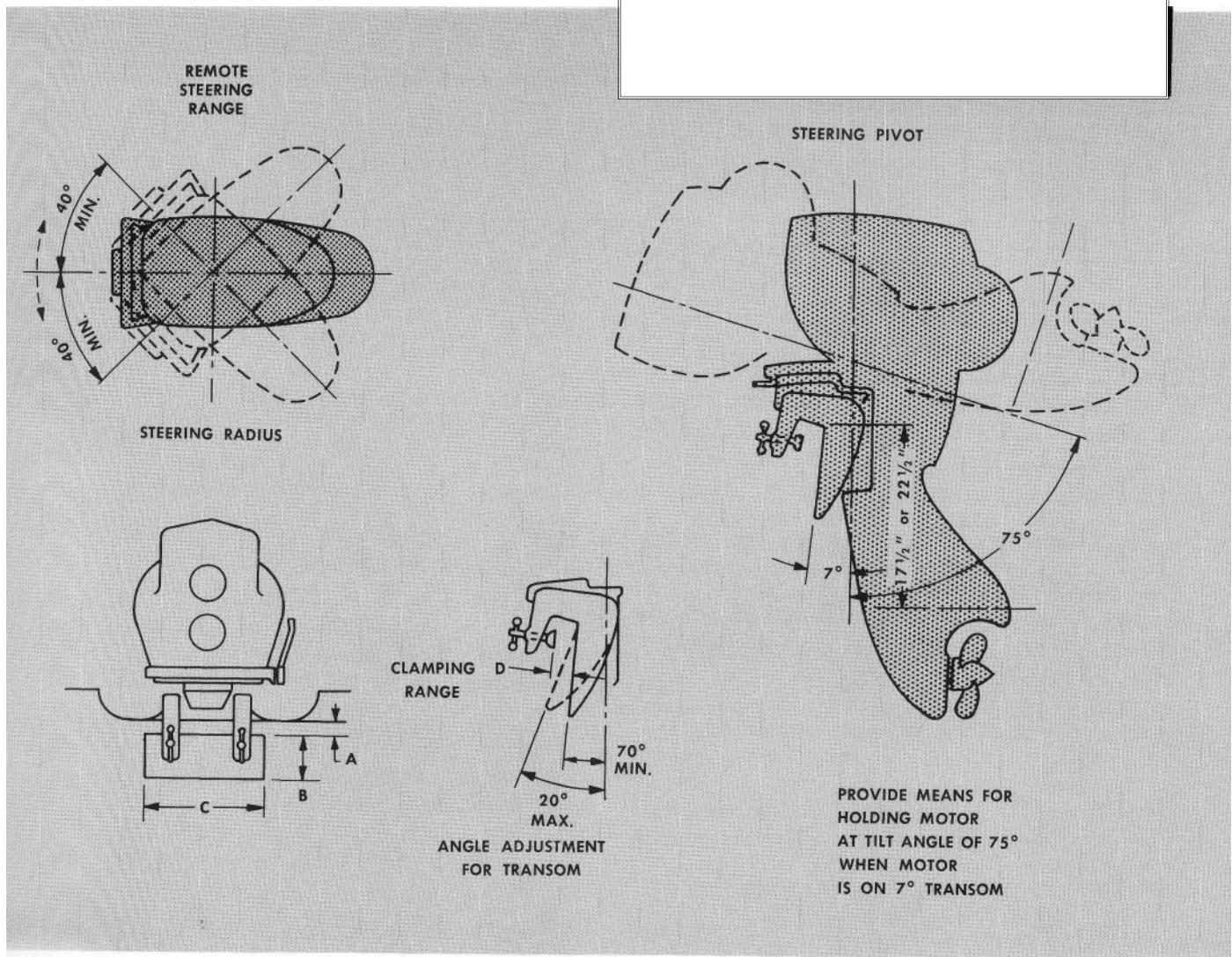
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BOAT ENGINEERING COMMITTEE



**BOAT STANDARDS
RECOMMENDED PRACTICE**

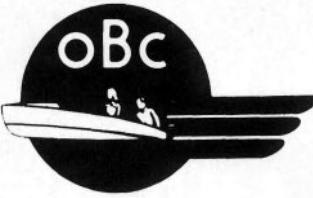
MOTOR DIMENSIONS



	UNDER 12 H.P.			12 H.P. THROUGH 40 H.P.			OVER 40 H.P.		
CLAMPING AREA	A	B	C	A	B	C	A	B	C
	58"	2 1/8"	8 1/4"	78"	3"	15 1/2"	34"	5"	15 1/2"
CLAMPING RANGE "D"	CLOSED	OPEN		CLOSED	OPEN		CLOSED	OPEN	
	1 1/4" MAX.	2 3/8" MIN.		1 1/4" MAX.	2 3/4" MIN.		1 1/2" MAX.	2 3/4" MIN.	

APPROVED

MOTOR ENGINEERING COMMITTEE



BOAT STANDARDS
RECOMMENDED PRACTICE

MOTOR HORSEPOWER RATINGS

OBC MOTOR HORSEPOWER CERTIFICATION AGREEMENT

Outboard Boating Club of America
307 North Michigan Avenue
Chicago 1, Illinois

Gentlemen:

We the undersigned, are manufacturers and/or distributors of outboard motors under our own brand name, and being in hearty accord with the purposes stated for the standardization of horsepower ratings for outboard motors, hereby agree to use only OBC Certified Brake Horsepower ratings under the following procedure and conditions, as established by the Standards Committee of the Outboard Motor Manufacturers Association.

This agreement shall be effective on the date of signature by us and shall continue in effect unless terminated by us on at least thirty (30) days written notice to the Executive Director of the Outboard Boating Club of America or by the Outboard Boating Club of America upon at least thirty (30) days written notice to us. On and after the date of the termination of this Agreement all certifications hereunder shall cease to be effective and we shall not, thereafter, use in any manner whatsoever any language or designation stating or indicating that any product of ours has an OBC Certification.

This Agreement may be modified or amended at any time upon obtaining specific written consent of all having the same Agreement.

Signed this _____ day of _____, 19_____

HORSEPOWER RATINGS

Certain standards and established procedures in the rating of outboard motors are followed by members of the Outboard Motor Manufacturers Association, an affiliate of OBC. These cover the accepted practice for rating the horsepower of outboard motors.

OBC provides for the certifying of the accuracy of motor horsepower of models produced by OMMA member firms by laboratory tests conducted by a recognized independent research

organization, assuring the purchaser of a high standard of manufacture and an honestly advertised product.

Engineers of competing OMMA firms witness the certification tests and verify the accuracy of test results.

The following is the complete draft of the OBC Horsepower Certification Agreement, agreed to by all OMMA member firms.

MOTOR HORSEPOWER RATING (Continued)

I. GENERAL PROCEDURES

- A. A member motor manufacturer may request a certification test by notifying the OBC office, which will fix a date for such test. This date shall not conflict with one previously assigned. At least ten (10) days in advance of the scheduled certification test, the OBC office shall notify all other member motomanufacturers and invite each to have one or more representatives present.
- B. The OBC office shall forward copies of the test data and the ratings determined to each party subscribed to this agreement within two (2) days after receipt of such ratings from the Certifier.
- C. The OBC Certified Brake Horsepower of any model may be redetermined:
 1. At the request of any of the parties to this Agreement (in which case the party making the request shall pay the certifier's charges for conducting such tests).
 2. At the request of the manufacturer, should he desire a recheck of results (see IV below).
- D. In case modifications are made in a production model affecting the power output, or the conditions of test in force at the time of the original certification, the following procedure will govern:
 1. If the power output is decreased: When fifty (50) engines have been produced, new tests shall be made as herein provided for a new model. The new OBC Certified Brake Horsepower, so determined, shall be adopted at once.
 2. If the power output is increased: New tests may be made and the new OBC Certified Brake Horsepower, so determined, may be adopted and used.
- E. Any manufacturer which has this same agreement may have the privilege of check testing his product on any approved dynamometer, at his own expense.

II. CERTIFICATION PROCEDURE

A. The Certifier

1. One and only one engineering organization, to be known as "Certifier", is to be selected by the Standards Committee of the Outboard Motor Manufacturers Association, and under terms and conditions agreed upon, shall re-

ceive compensation for their services from the organization which requested the test.

2. The Certifier shall witness brake horsepower tests to be run on outboard motors and certify to the accuracy of such tests and establish, from the data so obtained, the OBC Certified Brake Horsepower for each model so tested. Upon so determining the OBC Certified Brake Horsepower for any model of engine, the Certifier shall immediately file such ratings with the Outboard Boating Club of America.
- B. Selection of Engine for Tests (New or Previously Un-Tested Models)
 1. Not less than two engines or more than three (which may be experimental handbuilt models) shall be selected as herein provided.
 2. These engines shall have been constructed according to production specifications in all details effecting power output. The manufacturer of said engines shall supply to the Certifier an affidavit to this effect. Included in this affidavit shall be the total piston displacement in cubic inches of the engine to be tested.
 3. The engines to be tested shall be previously selected, permanently identified by number or other device, and when mounted on the testing dynamometer, shall be considered as having been selected.

III. CONDITIONS OF TEST

(New or Previously Un-Tested Models)

- A. The brake horsepower of each motor shall be determined in the presence of a representative of the Certifier.
- B. The r.p.m. at which the engine is to be rated shall be the midpoint of the recommended operating speed range of the engine.
- C. The brake horsepower shall be measured directly from the crankshaft or from any other point specified by the manufacturer. If the power is transmitted from the engine to the dynamometer through gears, then the resultant transmission loss may be determined and used in computing the brake horsepower from the readings.
- D. The engine under test may exhaust directly into the atmosphere with the muffler (or exhaust manifold or expansion chamber) removed or cut

MOTOR HORSEPOWER RATING (Continued)

away for that purpose, but no exhaust pipe may be added. It is not permissible to remove intake silencing devices or to add any parts to the intake of the motor. In all other respects, standard motor equipment without any parts removed or any new parts added shall be used. Cooling water may be provided from an outside source.

E. Tests on engines shall be made using commercially available gasoline and lubricating oil, or a mixture of such gasoline and lubricating oil, as recommended by the manufacturer for the model being tested. Lubricating devices, systems or equipment shall be the same as that sold as standard equipment on the motor. Excess lubricating oil may be used if desired.

F. New spark plugs, of the type used as standard equipment or any other "stock" spark plugs, may be installed in the engine at any time required during the test.

G. Each engine shall be run on a dynamometer for not more than thirty minutes accrued running time. At the end of each minute, during any part of this period, the following shall be recorded:

1. Speed—r.p.m.—(N)
2. Scale Reading of Dynamometer—(L)
3. Temperature of Room—Degrees F.—(T₀)
4. Pressure of Room—Inches mercury 32° F.—(P_c)
5. Water Vapor Pressure in Air of Room—Inches mercury—(P_w)

This is to be determined by the Wet and Dry Bulb temperature and psychrometric chart.

During a period of twenty seconds, starting ten seconds prior to each minute, no engine or dynamometer adjustments shall be made and the certifier shall use this period for taking load and r.p.m. readings.

The manufacturer conducting the test may select any five consecutive readings during continuous operation at rated speed for the purpose of computing horsepower.

The observed brake horsepower (33,000 ft.-lb. per minute) of each engine shall be calculated from the averages of the above five sets of readings by the formula: Observed Brake Horsepower = CNL, where C is the constant for the particular dynamometer in use. The observed brake horse-

power shall be corrected to standard conditions of 60° F. and 29.92" of mercury dry air pressure by the formula:

Corrected brake horsepower = Observed brake horsepower

$$\frac{29.92}{P_c - P_w} \sqrt{\frac{460 + T^o}{520}}$$

H. To the averaged corrected dynamometer horsepower of all air-cooled engines, the following shall be added to obtain the OBC Certified Brake Horsepower:

To engines registering up to 1 HP—add .10 HP

To engines registering 1 to 2 HP—add .15 HP

To engines registering 2 to 6 HP—add .20 HP

To engines registering 6 HP or over—add .25 HP

(Note: This is in lieu of the water pump power consumption not taken into account in testing water cooled engines.)

If the air-cooled engine incorporates a water pump driven by the engine, no allowance shall be made for power consumed in the cooling fan.

I. The corrected horsepower of any two of the three selected engines shall be averaged to obtain the Certified Brake Horsepower of the model engine being tested.

J. If the manufacturer is not satisfied with the results obtained from the first tests on any model engine, he may request a new test within ten days and await these results before changing or establishing the OBC Certified BrakeHorsepower. The results from either test may be used.

IV. REQUESTED RE-RUN ON PRODUCTION MODEL

A. A re-run may be requested by any of the parties to the agreement.

1. If requested by the manufacturer of the motor, the same procedure will be utilizedas selecting a new or previously un-tested model for testing as outlined in II, B, above.
2. If requested by any of the other parties to this agreement, three engines of the identical model (of which at least fifty such engines shall have been produced) shall be selected at random from the manufacturer's production stock by the Certifier for the re-testing of horsepower certification.

MOTOR HORSEPOWER RATING (Continued)

3. These selected motors will be tested in accordance with III, page 27.
- B. The corrected horsepower, as determined from two (2) of these three (3) selected engines determines as follows the action to be taken on the previously determined ratings:
 1. If the corrected horsepower is higher, the manufacturer may, if he chooses, use the new rating.
 2. If the corrected horsepower is lower, but not as much as 5% lower than the previously determined rating, the manufacturer may retain the previous rating.
 3. If the corrected horsepower is less by as much as 5% of the previously determined rating, the manufacturer must re-run within the following sixty (60) days to prove corrective steps have been taken or discard the previously determined rating in favor of the new one.
- C. These engines may be dismantled for inspection and adjustment but not for modification in any manner other than specified for regular production — and run in for not more than ten (10) hours before the test.
- D. Should any engine show as much as 15% less power than any other under test, then it may be disassembled for inspection and any faulty parts may be replaced by other regular stock parts, after which the test on this engine shall be run again. Any such engine may be withdrawn from the test, in which case it shall be replaced by another engine of the same model as selected in the first place.

V. USE AND DISPLAY OF OBC HORSEPOWER RATING

- A. Beginning with the yearly models next to be offered for sale, only OBC Certified Brake Horsepower shall be used, advertised and/or publicized.
- B. Not until two days have elapsed after the Out-Board Boating Club of America has forwarded

copies of the test data and the ratings determined there from to each party who has subscribed to this agreement shall such ratings become effective for use.

C. Horsepower ratings in use on any model prior to date of this agreement shall be discontinued at once except that, on such models as the manufacturer has in stock and definitely expects to discontinue as soon as the completed stock is exhausted, he may be permitted to use the old literature to help sell those models. No horsepower designations, however, shall be shown in any new literature printed, or in any reprints, except the OBC Certified Brake Horsepower.

D. The OBC Certified Brake Horsepower used in advertising and printed matter shall be no higher than the certified horsepower; and — this rating so adopted, shall be continued until other ratings similarly determined and expressed, are established.

E. Whenever OBC Certified Horsepower is stated, the speed in revolutions per minute at which this power is developed shall also be stated adjacent thereto.

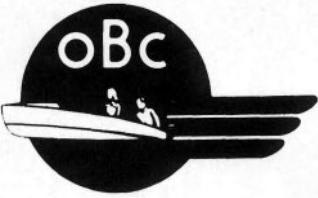
(Example: OBC Certified B. HP at — rpm)
Where repetition of this formula is undesirable, it shall be permissible to use the horsepower figure, provided however that said advertisements or printed matter also contain a prominent statement of the OBC Certified B. HP and rpm.

F. The OBC certified horsepower at — r.p.m. and a recommended full power operating speed range of the engine shall be shown in all engineering specifications and shall be used in advertising, owner and service manuals, and shall be displayed on a prominent place on the engine, preferably on the name plate.

G. No model number designation shall be used in selling, advertising, or publicity except a number which cannot possibly be construed as representing a horsepower higher than the OBC Certified Horsepower of that model.

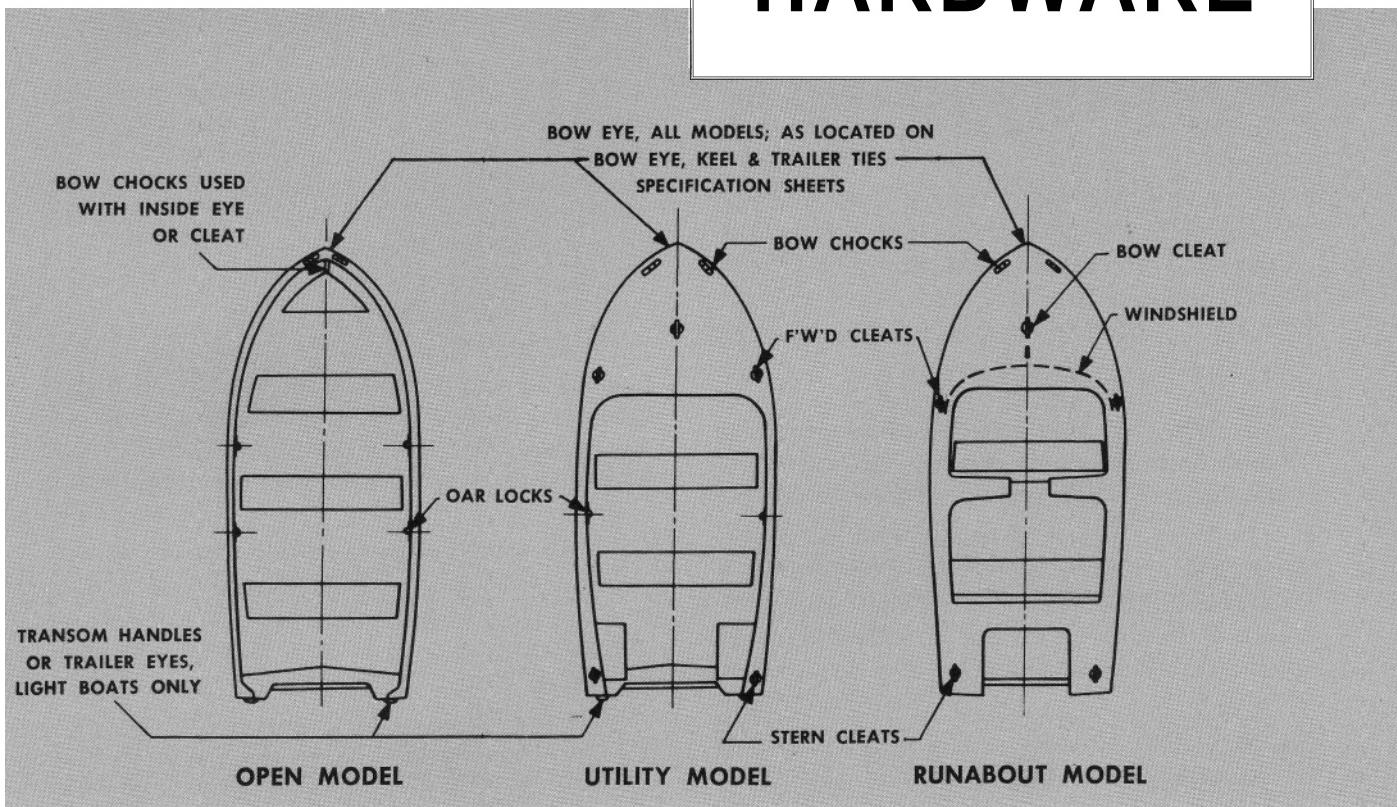
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MOTOR ENGINEERING COMMITTEE



BOAT STANDARDS
RECOMMENDED PRACTICE

MINIMUM DECK HARDWARE



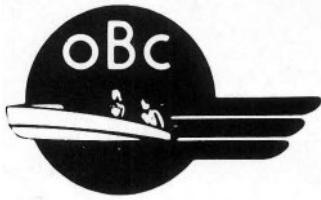
Boats shall be fitted with deck hardware of sizes adequate for mooring lines of the diameter indicated in the table below. As a minimum, #8 through fasteners shall be used for deck hardware wherever possible. Hardware shall be reachable from the cockpit, considering the location of wind-

shields and/or canopy tops. Items shown above, but not included in the table, shall be optional. These fittings shall not be used for lifting: Only those fittings specifically designed for lifting shall be used for that purpose.

MODEL	OPEN BOATS			UTILITY BOATS			RUNABOUTS		
	10'-13'	14'-17'	18'-up	10'-16'	14'-17'	18'-up	10'-13'	14'-17'	18'-up
BOW EYE	3/8"	3/8"	1/2"	3/8"	3/8"	1/2"	3/8"	3/8"	1/2"
BOW CHOCKS	—	—	—	3/8"	1/2"	1/2"	3/8"	1/2"	1/2"
BOW CLEAT	—	—	—	3/8"	1/2"	1/2"	3/8"	1/2"	1/2"
FORWARD SIDE CLEATS	—	—	—	3/8"	3/8"	1/2"	3/8"	3/8"	1/2"
STERN CLEATS	—	—	—	3/8"	1/2"	1/2"	3/8"	1/2"	1/2"

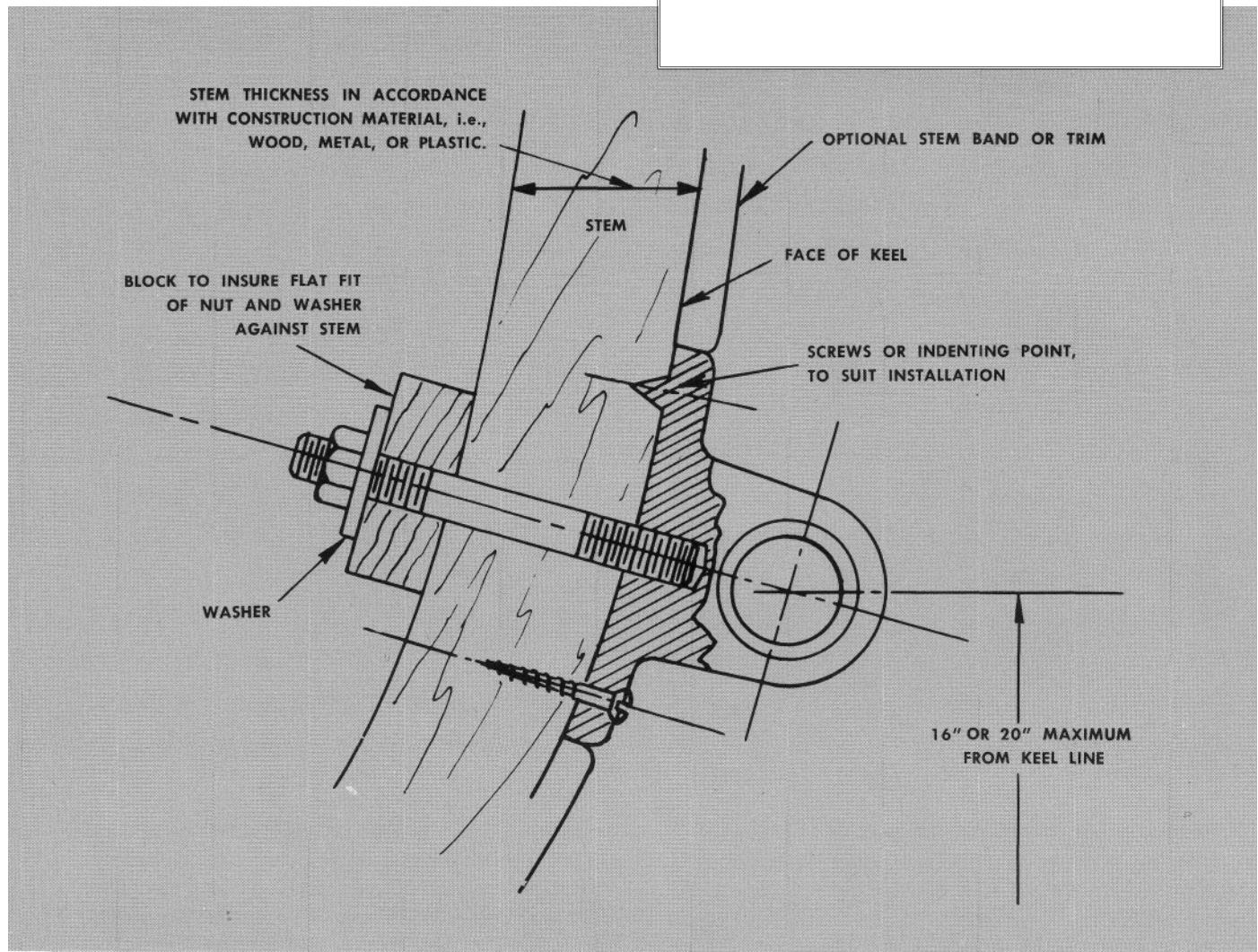
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BOAT ENGINEERING COMMITTEE
MARINE FITTINGS ENGINEERING COMMITTEE



**BOAT STANDARDS
RECOMMENDED PRACTICE**

BOW EYE SPECIFICATIONS

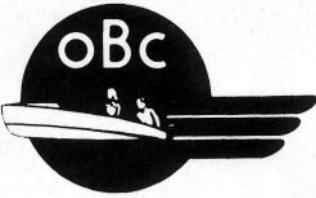


SPECIFICATIONS—A bow eye or strap, regardless of fabrication and installation, should be able to withstand a direct tension pull of twice the sum of the weight of the boat and its maximum OBC recommended weight capacity.

INSTALLATION—The bow should be located as specified on the Keel and Trailer Ties sheet (see page 7) and through bolted as indicated to suit hull construction and materials.

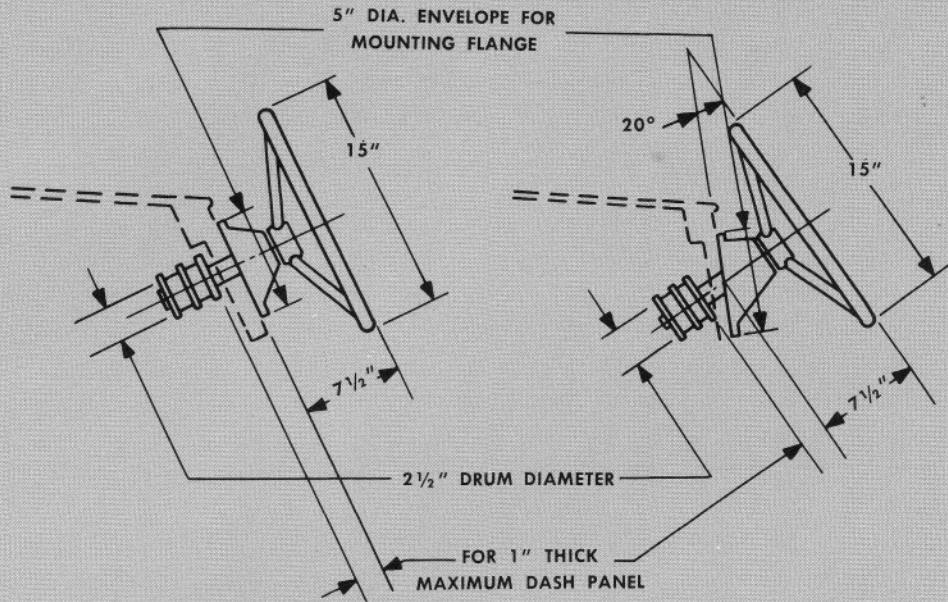
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MARINE FITTINGS ENGINEERING COMMITTEE



BOAT STANDARDS
RECOMMENDED PRACTICE

STEERING WHEEL DIMENSIONS



STEERING WHEEL MOUNTING MAY BE FOR
EITHER "THRU-DASH" OR "BENEATH-DASH" INSTALLATION.

NOT DRAWN TO SCALE

Steering wheel assemblies suitable for uniform installation shall be made available by the accessory manufacturers.

These standard wheels shall be 15" in diameter, and shall be fitted with dash mounting brackets which shall position the steering wheel face parallel to the dash or inclined 20° thereto, and 7 1/2" therefrom as measured along the axis of the steering column.

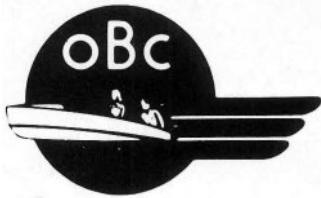
to permit installation on a dash panel not greater than 1" in thickness. In the case of mechanical steerers other than cable, the mechanical assembly

shall be located on the shaft centerline to permit installation on dash panels not greater than 1" in thickness.

Cable drums shall be not greater than 2 1/2" in diameter, and the mechanical ratio shall be such that there shall be approximately four turns of the drum center to 45° on the other side. The drums shall be provided with cable retaining flanges not less than 5/8" deep, measured from the drum surface.

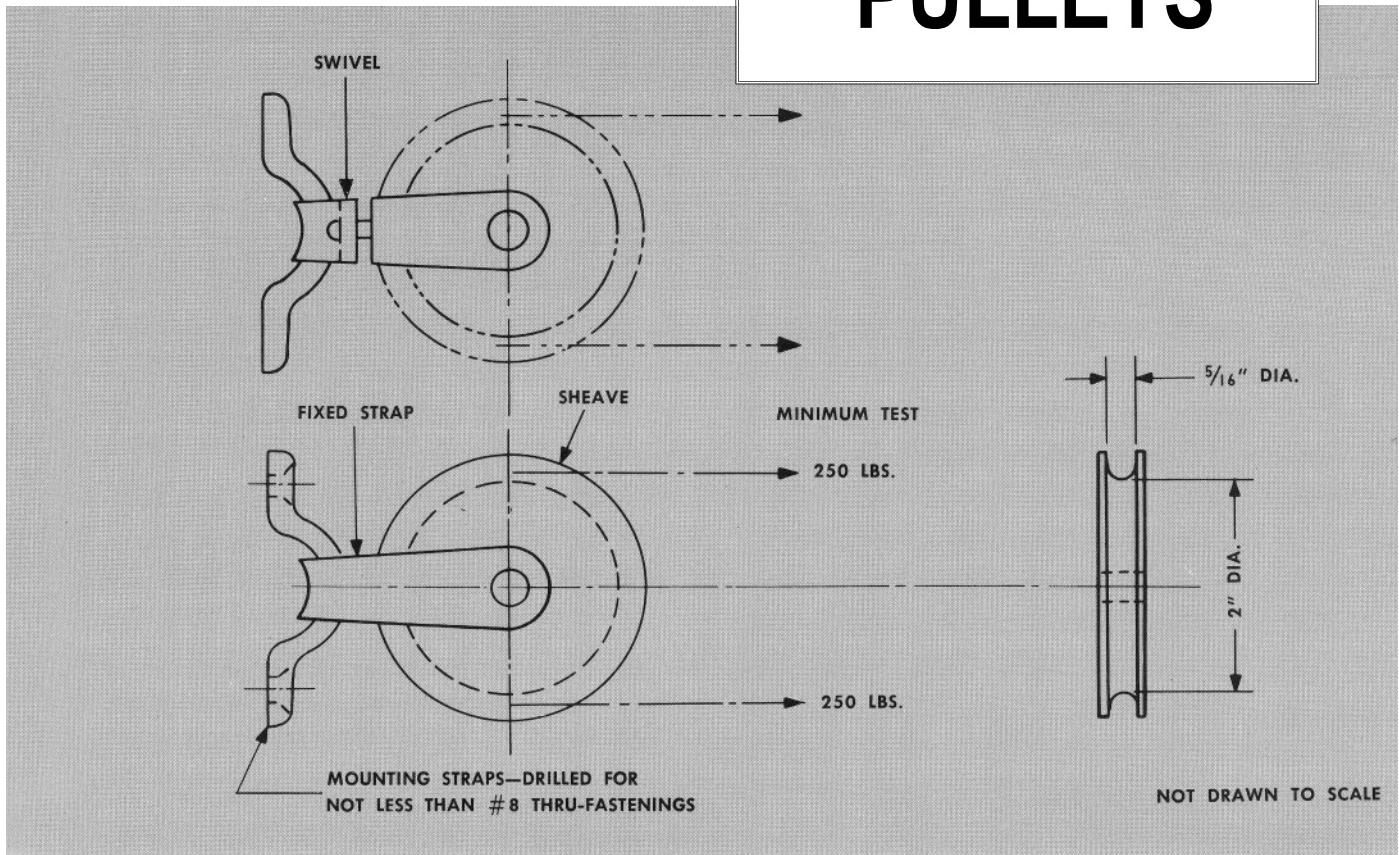
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BOAT STANDARDS
RECOMMENDED PRACTICE

STEERING SYSTEM PULLEYS



Pulleys for use with cable steering systems shall be of type suited to the installation in the boat.

No limitation shall be made as to the use of swivels, fixed strap, snap, fixed eye, or other type pulleys.

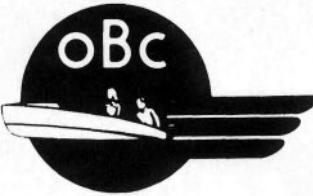
All pulleys shall, for best cable life, be fitted with sheaves having a root diameter not less than 2" and scored for cable not in excess of 5/16" diameter.

Pulley assemblies shall be capable of withstanding a pin load of at least 500 pounds without deflection and without noticeable increase in turning friction. Mounting straps for use with pulley shall be of section and size adequate to hold the pulley under the above test load without deformation.

(Note: Research tests demonstrate that a 2" pulley provides for three times as much life for steering cables as a 1/2" pulley.)

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BOAT ENGINEERING COMMITTEE
MARINE FITTINGS ENGINEERING COMMITTEE



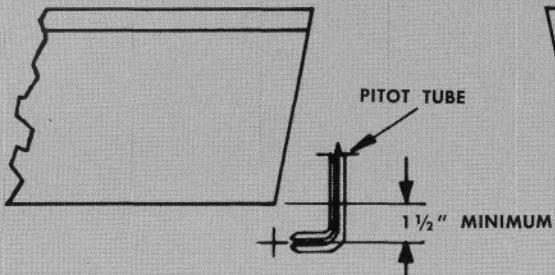
BOAT STANDARDS

RECOMMENDED PRACTICE

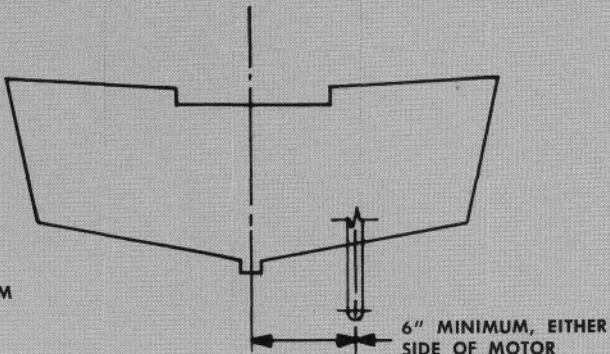
SPEEDOMETER INSTALLATION

(IMPACT PRESSURE TYPE)

PITOT LOCATION



AVOID DISTURBED WATER IMMEDIATELY ADJACENT TO PROPELLER AND HULL PROJECTIONS. PITOT TUBE OPENING MUST FACE BOW.



SPEEDOMETER INSTALLATION

The indicator dial shall be mounted so that it will be convenient to the boat operator and easily read by him.

Sharp bends, kinks and pinches in speedometer tubing are to be avoided, and all tubing connections shall be absolutely airtight. On those instruments requiring bleeding, bleed by momentarily disconnecting tubing from the meter after launching. Do not, however, bleed while the boat is under-way or in motion.

Use of a stabilizer shall be in accordance with the manufacturer's recommendations.

On larger boats, those over 20 feet in length, a through hull pitot tube is often used. Such a device shall be mounted in accordance with the manufacturer's recommendations. In installing a pitot tube with a dual motor arrangement, mount the pitot tube a minimum of six inches outboard of the center line of either motor.

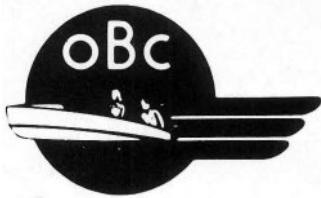
SPEEDOMETER CALIBRATION

The accuracy of a speedometer may be checked by running a straight course over a measured mile. Measure a mile course by use of a chart or landmarks, then run the course at a constant speed noting time of departure and arrival at predetermined points. Compare elapsed time with this table:

MEASURED MILE	
Speed	Elapsed Time
20 mph	180 seconds
25 mph	144 seconds
30 mph	120 seconds
35 mph	103 seconds
40 mph	90 seconds
45 mph	80 seconds

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MARINE FITTINGS ENGINEERING COMMITTEE



BOAT STANDARDS RECOMMENDED PRACTICE

COMPASS INSTALLATION

COMPASS INSTALLATION

The compass shall be located so that it will be convenient to the operator and easily read by him.

The compass should be located in an area clear of large steel objects and strong electrical fields for at least 12 inches on all sides. Radios, radio direction finders, indicators for electrical meters, electric windshield wipers and other similar devices should be at least three feet removed from the compass.

In installation, the compass should be temporarily placed into the selected location and all electrical accessories aboard should be operated to assure they will not influence its readings. Care should be taken to remove all metal tools, tool kits, and similar objects from proximity of the compass during this test. Special care should also be given to wheels should be rotated slowly, and any corresponding movement of the compass dial noted. If accessories or steering wheel affect the compass readings, the instrument should be moved to an unaffected location.

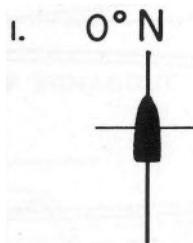
COMPASS ADJUSTMENT

Adjustment, or compensation, of a compass is usually needed to offset the magnetic pull of materials in the boat and to obtain readings of true magnetic directions.

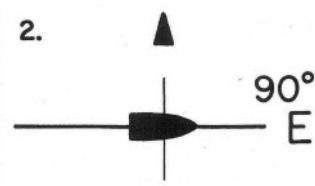
To adjust, or compensate, the compass, first select a true magnetic north-south course and a true magnetic east-west course, using a chart or map. Place the boat at the center, where the courses intersect.

Be sure the compensators are in a neutral position (see the manufacturer's instructions). A brass

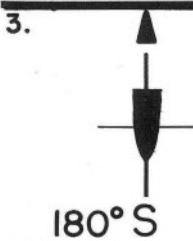
screwdriver, brass coin, or other non-metallic tool must be used to turn the compensators. As illustrated, the boat should be aligned successively on known true magnetic headings.



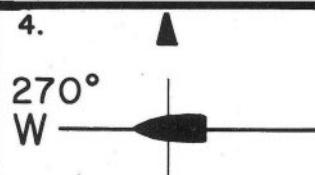
With the boat on a known north magnetic heading (0°) use the N-S compensators to adjust the reading to 0° .



With the boat on a known east magnetic heading (090°), use the E-W compensators to adjust the reading to 090° .



With the boat on a known south magnetic heading (180°), use the N-S compensators to reduce the indicated error by one-half. Thus, if the reading is 184° , adjust to read 182° .

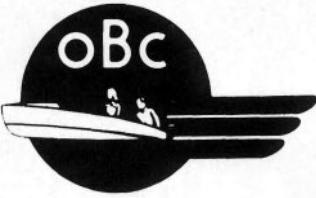


With the boat on a known west magnetic heading (270°), use the E-W compensators to reduce the indicated error by one-half. Thus, if the reading is 266° , adjust to read 268° .

Next, repeat all four steps, except reduce all indicated errors by one-half, including north (0°) and east (090°) headings. Continue until the desired accuracy is achieved. If all error cannot be removed, a deviation table may be prepared for standard compass increments and attached near the compass.

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BOAT ENGINEERING COMMITTEE
MARINE FITTINGS ENGINEERING COMMITTEE



BOAT STANDARDS RECOMMENDED PRACTICE

RUNNING LIGHTS

Navigational lighting under International Rules. (May optionally be displayed on the Great Lakes, Inland Waters and Western Rivers.)

OPEN RUNABOUT

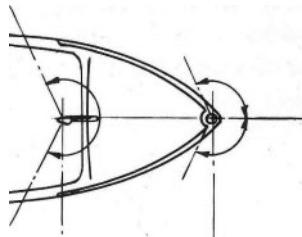
12 POINT WHITE AFT LIGHT,
VISIBLE 2 MILES, MAY BE
MOUNTED ON ENSIGN
STAFF IF MOTOR
OBSCURES VISIBILITY.



20 POINT FORWARD WHITE
LIGHT, TO BE VISIBLE 3 MILES,
MOUNTED HIGHER THAN
COMBINATION LIGHT.

COMBINATION LIGHT MAY BE
MOUNTED IMMEDIATELY ABAFT
THE BOW HANDLE, BUT
SHOULD NOT EXCEED 13"
FROM THE STEM.

WHITE AFT LIGHT MAYBE
MOUNTED ON DECK IF
VISIBILITY IS
UNOBSTRUCTED.

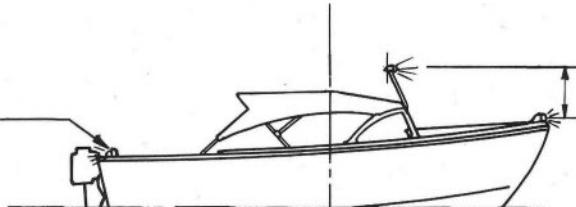


RED-GREEN COMBINATION
LIGHT TO BE VISIBLE FROM
AHEAD TO 2 POINTS ABAFT
THE BEAM AT ALL
RUNNING TRIMS.

CANOPY OR HARD-TOP RUNABOUT

WHITE AFT LIGHT

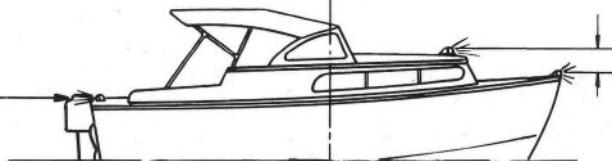
20 POINT FORWARD LIGHT
MUST BE HIGHER THAN
COMBINATION LIGHT.



EXPRESS TYPE CRUISER

WHITE AFT LIGHT

20 POINT FORWARD WHITE
LIGHT MAY BE MOUNTED ON
CABIN TRUNK IF HIGHER
THAN COMBINATION LIGHT.

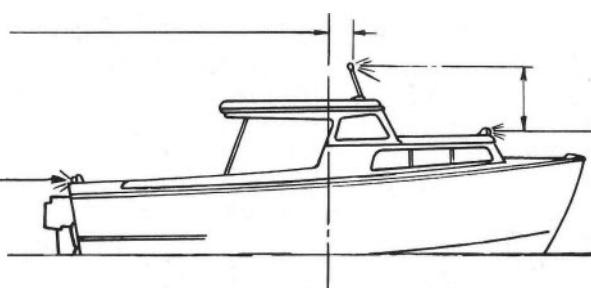


SEDAN OR TRUCK CABIN CRUISER

20 POINT FORWARD WHITE
LIGHT MUST BE FORWARD OF
AMIDSHIPS.

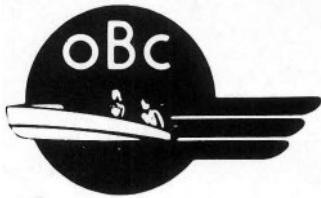
COMBINATION LIGHT MAY BE
MOUNTED ON CABIN TRUNK
IF LOWER THAN 20 POINT
FORWARD WHITE LIGHT.

WHITE AFT LIGHT



AFTER HALF LENGTH

FORWARD HALF LENGTH



BOAT STANDARDS RECOMMENDED PRACTICE

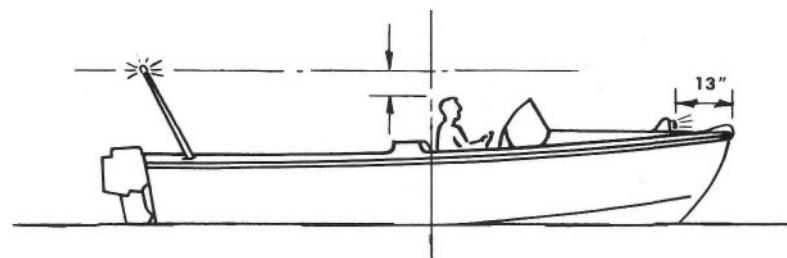
RUNNING LIGHTS

(CONTINUED)

Navigational lighting under the Motorboat Act of 1940. (Displayed on Federal waters of the United States.)

OPEN

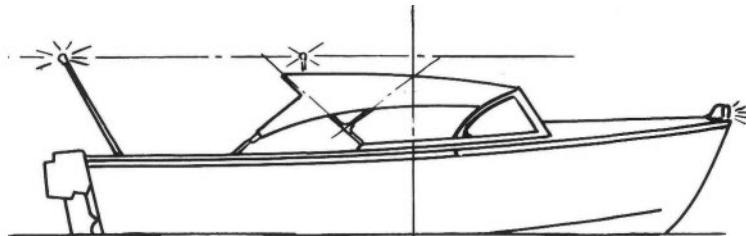
32 POINT WHITE AFT LIGHT, TO BE VISIBLE ALL AROUND THE HORIZON 2 MILES, TO BE VISIBLE ABOVE PASSENGERS' HEADS, WINDSHIELD, ETC.



COMBINATION LIGHT MAY BE MOUNTED IMMEDIATELY ABAFT THE BOW HANDLE, BUT SHOULD NOT EXCEED 13" FROM STEM. (NOT A LEGAL REQUIREMENT.)

CANOPY OR HARD-TOP

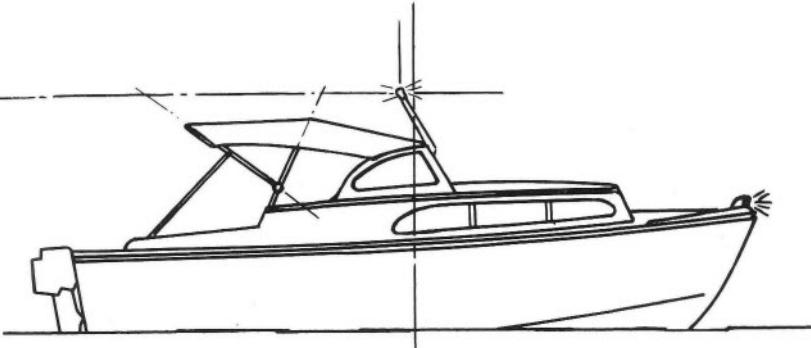
WHITE AFT LIGHT TO BE VISIBLE ABOVE WINDSHIELD OR CANOPY TOP AT ALL RUNNING TRIMS.



WHERE CANOPY TOP IS FIXED, THE AFT WHITE LIGHT MAY BE MOUNTED THEREON, PROVIDING IT IS ABAFT AMIDSHIPS.

EXPRESS TYPE CRUISER

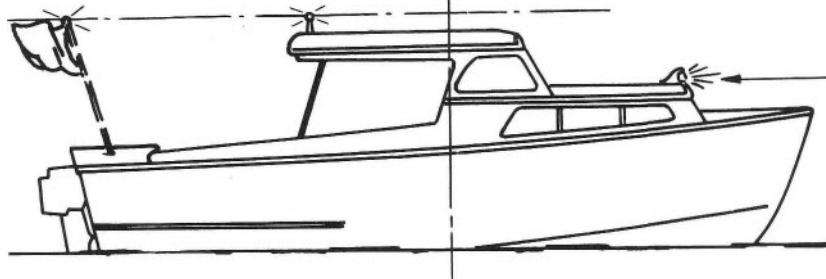
WHITE AFT LIGHT MAY BE ATOP ENSIGN STAFF IF AROUND THE HORIZON.



RED-GREEN COMBINATION LIGHT, TO BE VISIBLE FROM AHEAD TO 2 POINTS ABAFT THE BEAM AT ALL RUNNING TRIMS.

SEDAN OR TRUCK CABIN CRUISER

WHITE AFT LIGHT MAY BE LOCATED ON WINDSHIELD OR MAST IF RAKED ABAFT AMIDSHIPS.



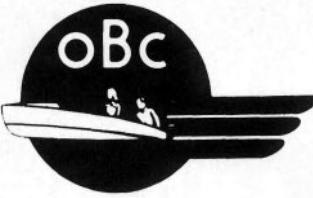
COMBINATION LIGHT MAY BE MOUNTED ON CABIN TRUNK, IF VISIBILITY IS UNOBSTRUCTED AND IT IS FORWARD OF AMIDSHIPS.

AFTER HALF LENGTH

FORWARD HALF LENGTH

NOTE

There are 32 points in a full circle of 360°, thus one point equals 11 1/11°.



BOAT STANDARDS RECOMMENDED PRACTICE

RUNNING LIGHTS

(CONTINUED)

NAVIGATIONAL LIGHTING

The preceding pages illustrate the location of navigational running lights for outboard boats under international and federal rules. A much more detailed description of lighting requirements may be found in the well known book on seamanship by Charles F. Chapman: (PILOTING, SEAMANSHIP AND SMALL BOAT HANDLING, 1957-8 Edition, published by MoTor BoatinG, 572 Madison Avenue, New York, N. Y.)

Briefly, however, outboards usually carry lights prescribed under either international rules (which may be optionally carried on the Great Lakes, Western Rivers and Inland Waters), or under the federal rules for "navigable waters of the United States." In addition, many state laws duplicate the federal requirements for their own (non-federal) waters.

These lights must be displayed at night. Boats operating only in daylight are not required to carry or display navigational lights.

FEDERAL RULES

The Motorboat Act of 1940, as amended, prescribes navigational lights for four classes of motorboats. Outboards of Class A (under 16 feet) and Class 1 (16 to 26 feet) carry the same lights.

These are:

1. A "bright" white light aft, to show 32 points or all around the horizon, visible at least two

miles, and placed higher than the combination light.

2. A 10 point red-green combination light, showing red from dead ahead to two points abaft the port beam, and green from dead ahead to two points abaft the starboard beam, visible at least one mile, and placed lower than the white light.

These same rules are duplicated by the several pilot rules covering various areas of the country. These rules apply to boats under power alone, and not to motorboats under sail.

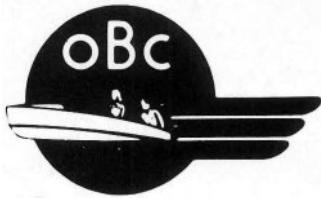
INTERNATIONAL RULES

Outboards operating in coastal waters defined as international waters must carry a different set of running lights, which, as noted above, may also be carried on some inland waters. These are:

1. A 12 point white light aft.
2. A 20 point white light forward, visible three miles, and placed higher than the colored lights described below.
3. Red and green side lights, red on port side, green on starboard side, each showing from dead ahead to 2 points abaft the beam; or
A red-green combination light, similar to federal rules.
4. When at anchor, a 32 point white light, visible all around the horizon.

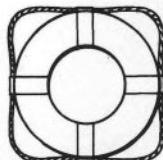
APPROVED

BOAT ENGINEERING COMMITTEE
MARINE FITTINGS ENGINEERING COMMITTEE



BOAT STANDARDS
RECOMMENDED PRACTICE

COAST GUARD REQUIREMENTS



EQUIPMENT REQUIRED BY LAW ON FEDERAL WATERS

According to provisions of the Motorboat Act, outboard boats of Class A (under 16 feet) are required to have the following equipment aboard while operating on federal waters. These regulations are duplicated in many state boating laws:

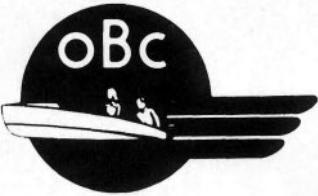
1. Lights, if operated at night (see pages 36-38).
2. One Coast Guard approved life preserver, buoyant cushion, buoyant vest or ring buoy, in serviceable condition, and readily accessible, for each person on board.
3. A fire extinguisher, if of closed construction (see Fire Protection Standards Section). Open outboards need not carry an extinguisher.

Outboards of Class 1 (16 to 26 feet) must carry the following:

1. Lights, same as for Class A (see pages 36-38).
2. Life preservers, same as for Class A above.
3. Fire extinguisher, same as for Class A above.
4. A hand, mouth, or power operated whistle or horn audible for at least a half mile.

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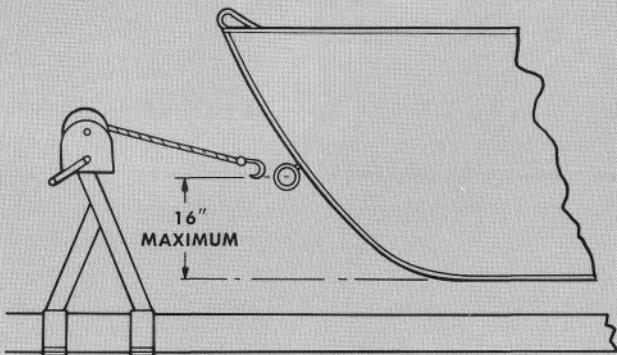
BOAT ENGINEERING COMMITTEE
MARINE FITTINGS ENGINEERING COMMITTEE



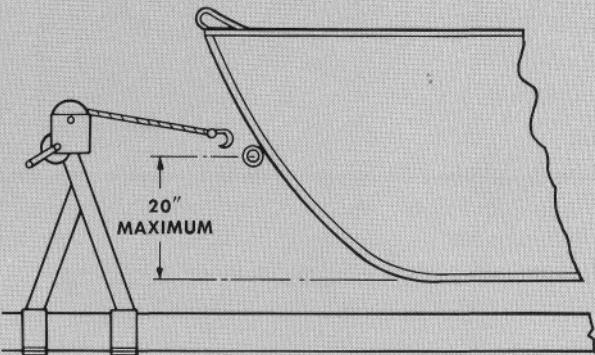
BOAT STANDARDS RECOMMENDED PRACTICE

WINCH ASSEMBLY

16' OR LESS



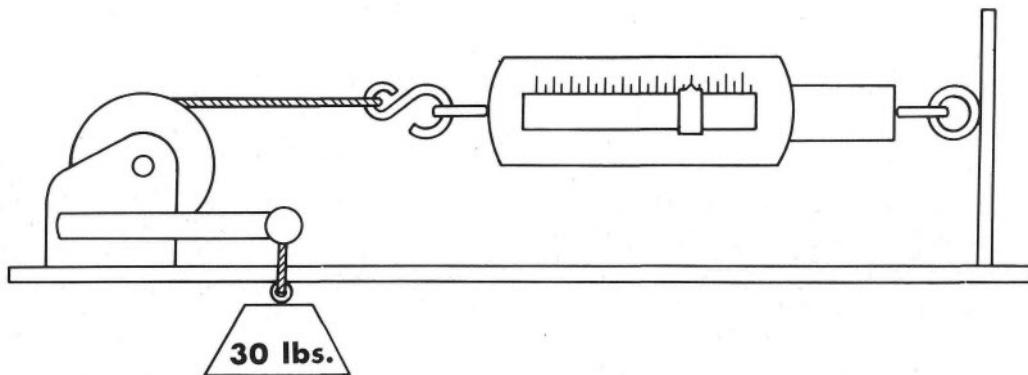
OVER 16'



WINCH CONSTRUCTION

The winch assembly shall be constructed so that it will be harmonious with the recommended standards for bow eyes: That is, a maximum height of 16 inches from extended keel line to bow eye for boats up to and including 16 feet

in length, and a maximum height of 20 inches from keel line to bow eye for boats more than 16 feet in length. (See Keel and Trailer Ties, page 7).



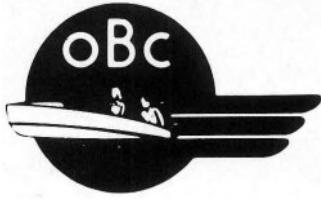
WINCH CAPACITY

The stated capacity of the winch shall be the direct lift weight determined when 30 pounds of pull are applied on the handle with at least 20 feet of rope or cable (whichever is furnished) on the drum.

A winch may be tested for the above standard by use of a spring extension scale, hanging a 30 pound weight on the handle when the handle is in a horizontal position, as illustrated above,

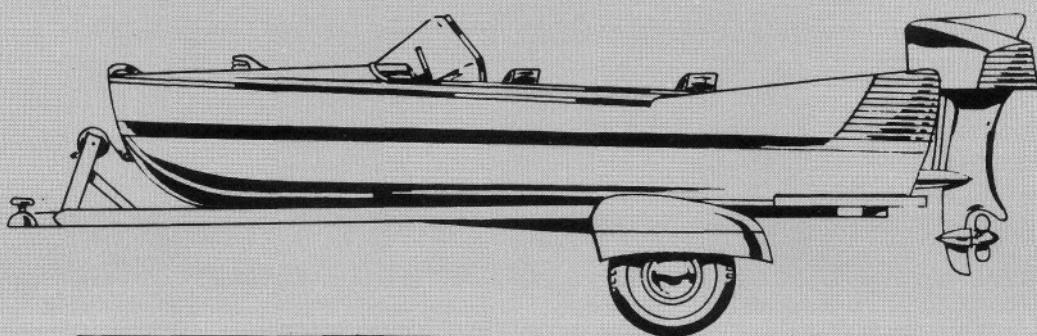
APPROVED

BOAT TRAILER ENGINEERING COMMITTEE



BOAT STANDARDS
RECOMMENDED PRACTICE

ADVERTISED TRAILER LOAD CAPACITY

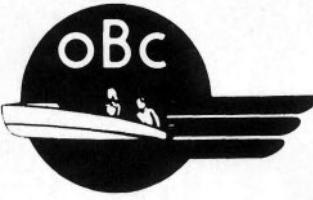


The stated maximum load capacity of a boat trailer, including boat, motor and gear carried, shall be determined by the following table:

STATED MAXIMUM LOAD CAPACITY	TEST AT STATED CAPACITY PLUS
Under 1,000 lbs.	50%
1,000 up to 1,250 lbs.	40%
1,250 up to 1,500 lbs.	30%
1,500 lbs. and over	25%

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BOAT STANDARDS
RECOMMENDED PRACTICE

TIRE LOAD CAPACITIES

Tire load capacities at 50 m.p.h. as determined by the Tire and Rim Association shall be used:

TIRE SIZE	PLY	LOAD CAPACITY, EACH	MAXIMUM INFLATION
4.80/4.00 x 8	4	465	60
4.80/4.00 x 8	6	570	85
5.70/5.00 x 8	4	565	45
5.70/5.00 x 8	6	730	70
5.70/5.00 x 8	8	845	90
'5.50/5.00 x 8	4	700	45
'5.50/5.00 x 8	6	900	65
*5.50/5.00 x 8	8	1100	80
6.90/6.00 x 9	4	830	45
6.90/6.00 x 9	6	940	55
6.90/6.00 x 9	8	1130	75
6.90/6.00 x 9	10	1290	95
4.80/4.00 x 12	4	615	60
5.30/4.50 x 12	4	775	55

NOTE

Consult Tire and Rim Manufacturers Data Book for recommended rims and measurements of rims.

*This size does not appear in the Tire and Rim Association's Year Book. Load is set by the individual manufacturer.

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BOAT STANDARDS RECOMMENDED PRACTICE

TRAILER SPECIFICATIONS

The following standards are established to aid boat trailer manufacturers in providing service to the trailer owner, wherever he may travel with his boat and trailer.

It is recognized that the failure of any one of

the following could cause extensive delays to the trailer owner when traveling, making the availability of standard interchangeable replacement parts vitally necessary.

TIRES

The sizes and capacities as recommended under "Tire Load Capacities" shall be standard in use with either the 8", 9" or 12" wheels. It will be noted that these three basic sizes are all non-automotive.

To encourage the tire dealers throughout the country to carry such sizes in stock, the BTMA Standards Committee has confined recommendations to such sizes.

WHEELS

Within the load capacity recommendations (see Advertised Trailer Load Capacity Sheet), 8", 12" and 9" wheels shall be used.

WHEEL BEARINGS

The 07100 or the L44649 bearing shall be used on trailers having 8" and 12" wheels. On trailers having 9" wheels the straight spindle application should use the LM 67048 while the tapered spindle application should use the 09074 outer bearing and the 15118 inner bearing.

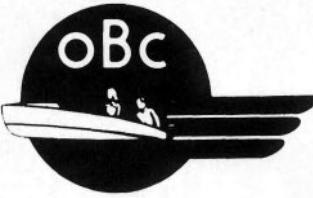
For boat trailer service, these bearings have a capacity adequate to carry any loads that the tire and corresponding spindle will sustain.

The seal surface shall be concentric with the bearing surfaces.

It is not recommended that a pressure grease fitting be installed on the hub.

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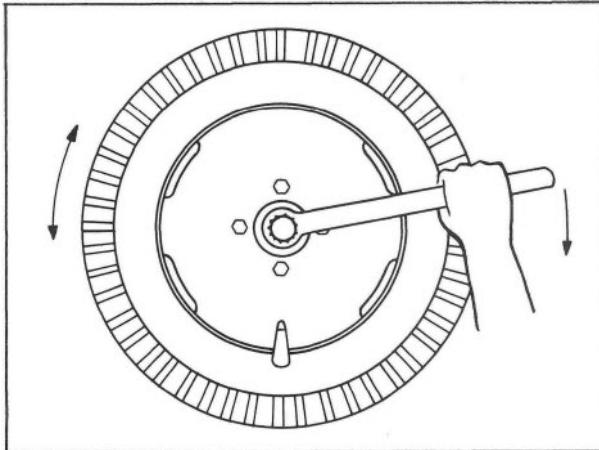


BOAT STANDARDS
RECOMMENDED PRACTICE

TRAILER SPECIFICATIONS

(CONTINUED)

WHEEL BEARING ADJUSTMENT



For single adjustment nut, tighten with a 12" wrench while turning the wheel in alternate directions until there is a slight bind created by the bearing contacting the cup. Back off adjusting nut 1/6 to 1/4 turn or to the nearest locking hole to allow the wheel to rotate freely within limits of .001" to .010" end play. Lock nut at this position.

BEARING LUBRICATION

Fill wheel hub with grease to inside diameter of outer races and also fill hub grease cap. Never use grease heavier than 265 A.S.T.M. penetration (No. 2 grade).

SPINDLES

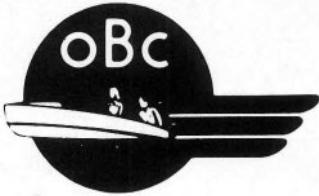
The length of the spindle shall be 4-1/16" from shoulder to tip when used with 8" and 12" wheels and 1/2" thick spindle nut. With a full size spindle

nut a 4-5/8" length spindle is recommended.

For 9" wheels the length of the spindle shall be 4" (see hub drawing on following page).

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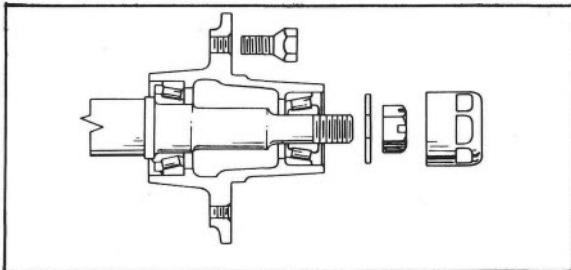


BOAT STANDARDS
RECOMMENDED PRACTICE

TRAILER SPECIFICATIONS

(CONTINUED)

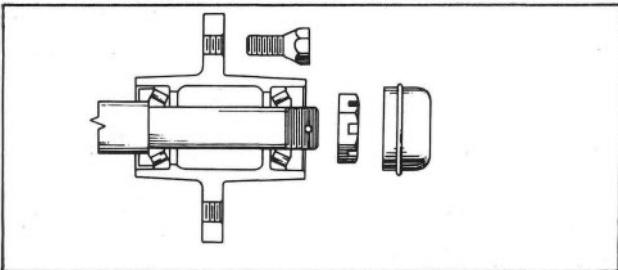
HUB



RIMS

On the four bolt hub for the 8" and 12" wheel the four inch bolt circle shall be standard.

On the 5 bolt hub for the 9" wheel the 4-1/2" bolt circle shall be standard.



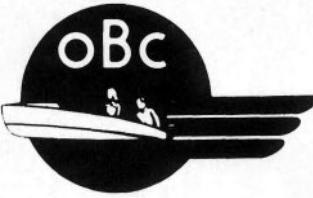
SPINDLE ASSEMBLY

It is recommended that rims should conform with diameter and tolerances recommended by the tire and rim association. Hub nuts on demountable hubs shall be adjusted according to the wheel manufacturers' recommendations. To prevent wheel failure, wheel nuts or studs should be kept tight. It is recommended that wheel nuts, or studs, be checked for tightness before the trailer is first towed and again between the first 50 and 100 miles of travel. Caution: Be certain that the taper of the nut, or stud, corresponds with the taper in the bolt hole.

It is recommended that spindle manufacturing shall be in accordance with the recommended tolerances and surfaces as set forth by the manufacturers of bearing and seals used. It is recommended that the sealing surface be machined as an integral part of the spindle. In using a spacer, the weld should be continuous around the spacer and the spacer be machined on the outer surface after welding to assure concentricity.

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BOAT STANDARDS
RECOMMENDED PRACTICE

TRAILER SPECIFICATIONS

(CONTINUED)

TRAILER BALL

On trailers having a maximum load capacity of less than 1500 pounds (see Advertised Trailer Load Capacity sheet), the 1-7/8" ball shall be standard equipment.

SERIAL NUMBER

A plate carrying the manufacturers name and serial number for that particular trailer shall be permanently attached to each trailer.

CLAMPING DEVICE

Trailers shall be furnished with resilient tie-down attachments for the bow of the boat.

TAIL AND STOP LIGHT

A 3" minimum diameter tail and stop light with illuminating light for license shall be available.

BRAKES

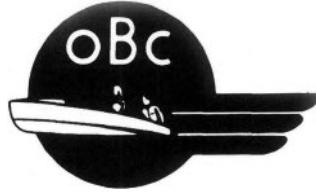
Brakes should be made available in accordance with state laws.

FRAME TYPE HITCH

Frame type hitches shall be used for towing boat trailers.

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FIRE PROTECTION STANDARDS

RECOMMENDED PRACTICE

INTRODUCTION: There are few other uses of petroleum fuels by the public in which the fire and explosion hazards parallel those possible in motor craft. The purpose of these Standards is to provide guidance for the prevention of fuel leakage, the elimination of possible sources of vapor ignition from particularly dangerous locations, the provision of adequate means for keeping vital areas ventilated at all times, the avoidance of unnecessary use of combustible materials in exposed locations and the provision of proper fire extinguishing equipment.

The following standards for fire protection were prepared with the cooperation of OBC by the Committee on Fire Protection of the National Fire Protection Association. They were first published in May 1957 by NFPA in "Fire Protection Standards for Motor Craft" (NFPA No. 302), a copyrighted booklet containing standards covering both inboard and outboard powered craft. The recommendations applicable to outboards are published here in full with permission of NFPA. The complete standards are available at fifty cents a copy from the National Fire Protection Association, 60 Batterymarch Street, Boston 10, Massachusetts.

These Standards indicate what is currently considered free from the fire hazard as practicable. It is intended that they serve as a guide for that purpose. Where strict compliance results in practical difficulty, exception from literal interpretations may be made, if equivalent protection is otherwise secured.

DEFINITIONS —SHALL indicates provisions considered essential. SHOULD indicates advisory provisions. Any question relative to such provisions should be referred to the authority having jurisdiction.

- (a) APPROVED—acceptable to the authority having jurisdiction.
- (b) ACCESSIBLE—capable of being reached for proper inspection, maintenance or removal without disturbance of permanent hull structure.
- (c) READILY ACCESSIBLE—capable of being reached quickly and safely for effective use under emergency conditions and reached conveniently under normal conditions.

FIRE PROTECTION

OUTBOARD POWERED BOATS

Chapter 1. HULL

11. ARRANGEMENT.

111. The arrangement of the hull shall be such that all compartments are as accessible as practicable, escape hatches are readily accessible and adequate for the designed purpose and the engine is readily accessible.

- (a) Enclosed engine compartments (when used) should be accessible and well ventilated.
- (b) Drip pan should be provided inside the transom below the engine to catch fuel drip. The drip pan should be provided with an overboard drain of not less than $\frac{1}{4}$ " inside diameter.
- (c) Adequate provisions should be made for drainage of bilges. Sufficient drain outlets and bilge pump suction should be installed to facilitate complete flushing and cleaning of bilges, whether hauled out or afloat.
- (d) Escape and access hatches shall not be obstructed.

112. Passages through accommodation spaces should be as free from obstruction as possible and means for escape shall be provided both forward and aft.

113. The galley or area used for galley purposes within a multiple purpose compartment shall be so laid out as to assure adequate ventilation.

12. FINISHING AND INSULATING MATERIALS.

121. Combustible materials shall not be used for acoustical or thermal insulation of compartments.

122. Within the galley area fabrics used for decorative or other similar purposes shall be noncombustible.

123. Combustible fabrics should not be used for finishing interior surfaces such as cabin ceilings and sidings.

13. VENTILATION. For the purpose of this section, ventilation is defined as induction of a directed current of air by natural or mechanical means in distinction from venting which only provides openings for escape

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ENGINEERING COORDINATION COMMITTEE

Fire Protection Standards —Continued

means the creation of a current of air from outside to outside through the length of compartment and not mere turbulence.

131. Any compartment or space in which an engine is located, particularly the lower portion and bilges, shall be provided with ventilation capable of preventing and effective to remove accumulation of flammable or explosive vapor.

(a) Fuel tank compartments should have similar ventilation provisions.

132. The following provisions are recommended for compartment ventilation:

- (a) Permanently open and unobstructed inlet and outlet ventilating ducts extending to bilges should be installed with two ducts serving as inlets leading to the wings at one end of the compartment and two ducts serving as outlets from the wings at the opposite end.
- (b) Cross sectional areas of the individual ventilation ducts within a compartment should be the same. The aggregate inlet area and the aggregate outlet area should each be proportioned approximately to the beam of the boat with 2 sq. in. of aggregate inlet or outlet duct area per foot of beam as the minimum.
- (c) Exterior terminations of all ventilating ducts should be provided with unobstructed cowls or equivalent fittings having minimum openings equal to the ducts. Flush or recessed inlets and transom louvre outlets do not comply with this requirement.
- (d) A preferred arrangement utilizes the after ventilating ducts as inlets and the forward ventilating ducts as outlets, with the cowls of the after (inlet) ducts trimmed forward and on a higher plane than the cowls of the forward (outlet) ducts which are trimmed aft. The relative difference in elevation between the inlet cowl opening and the outlet cowl opening should be a minimum of 4 inches.

133. Where engines and/or tanks are not in closed compartments, at least one ventilating duct should be installed in the fore part of the boat and one in the after part, both provided with exterior fittings as per Para. 132 (c).

134. The fitting of outlet ventilating ducts with wind actuated self trimming or rotary exhauster heads, or with power operated exhaust blowers is recommended.

(a) If power exhaust blowers are used, motors shall be installed outside of ducts and as high above the bilge as possible. Location of power exhaust blowers just under the deck at side is recommended with inspection or repair access provided by easily removable panels or otherwise.

14. LIGHTNING PROTECTION.*

141. Metallic fittings at extremities of wooden masts and yards should be effectively grounded and all metallic structural parts or accessories of any appreciable size, installed on the spars, should be connected to the grounding conductor.

(a) A recommended means for grounding is the use of No. 4 copper wire properly secured to spars and led directly as practicable to a ground plate attached to the wetted surface of the hull.

*See Code for Protection Against Lightning (NFPA No. 78) published in National Fire Codes, Vol. V and in separate pamphlet by the National Fire Protection Assn.

(b) Metallic standing rigging should be effectively connected from lower ends to the common ground.

142. Radio antennas shall be provided with means for grounding during electrical storms in accordance with Paragraph 141 (a) or by exterior lead to suitable grounding underwater.

(a) Grounding of radio antennas constitutes sufficient protection for wooden boats without masts and spars.

143. A steel hull is an adequate ground and in a steel hull with steel masts if there is good metallic connection between hull and masts no further protection from lightning is necessary.

144. Lightning protection provisions are quite likely to receive scant attention and therefore its composition and assembly should be strong and materials used should be highly resistant to corrosion. Bends in the grounding conductor should be kept to a minimum.

Chapter 2. ENGINES

21. ENGINES. Engines should be suitable in type and design to operate at full rated capacity continuously without overheating or having heated surfaces that would constitute a fire hazard to adjacent material.

211. The mounting of the engine should be such that the engine will operate in its normal position and have ample clearance for tilting and steering through the normal expected range for the particular type and design engine.

- (a) Engines mounted so as to have complete enclosures shall have ample ventilation to prevent excessive accumulation of exhaust gases or fuel vapors.
- (b) Engines having hatch covers hinged to boat maybe located and mounted in such a manner that when tilting engine said covers may hinge or move with engine so that engine may have full range tilting as normally expected for that type and design of engine.

212. The magneto should be designed that fuel vapors around engine will not be ignited from breaker point sparking. This requirement is necessary only on engines having enclosures sufficiently tight to retain fuel vapors.

213. Spark plugs shall have covers or shields so as to prevent sparking that may result from accumulation of water, salt crystals, or other foreign material on insulators.

214. Carburetors and intake system shall be "backfire" proof, or be equipped with flame arrester. This requirement is necessary only on engines having enclosures sufficiently tight to retain fuel vapors.

215. Starters or generators having brushes should be of the "non-ventilated" type so as to prevent the ignition of fuel vapors by sparking in operation.

216. Air-cooled engines should operate completely in the open with no hatches or air restricting structures near air inlets or outlets.

217. Covers, component parts and flat surfaces should be designed so as to drain away any fuel spillage quickly.

218. Carburetor float valves should have sufficient control over fuel entering bowl to withstand normal pressure on fuel exerted by manual pump used to fill carburetor for initial start of engine.

Fire Protection Standards — Continued

22. AUXILIARY ENGINES.

221. Air-cooled gasoline engines providing primary power for generators or other auxiliaries may be used under deck provided:

- (a) Compartment ventilation is adequate to meet the needs of engine cooling systems.
- (b) Air used for engine cooling is discharged outside the hull by a duct system, designed and installed to prevent entry of water.
- (c) Engine exhaust system is water cooled and installed in accordance with Para. 232.
- (d) A suitable audible warning alarm is installed to indicate any failure of water flow in the exhaust system.

222. Air-cooled engines with self-contained fuel systems may be used only on open decks outside coamings or on cabin tops and any housing over such units shall be open whenever engine is operated.

223. Unsecured portable engines shall not be used.

23. ENGINE EXHAUST. Engine exhaust should be under water. Any openings in exhaust system above waterline should be designed so as to avoid ignition of fuel vapors.

Chapter 3. FUEL SYSTEMS

30. Because of the fire and explosion hazards from leaking fuel in boats it is imperative that the materials used, the design, the construction and the installation of all parts of fuel systems be to the highest standards.

31. FUEL TANKS. - Permanently installed type.

Note: No pressurized tanks shall be built into or permanently attached to hulls.

311. MATERIALS.

- (a) Fuel tanks permanently installed within the hull shall be constructed of corrosion-resistant metals and alloys, or of iron or steel both of which shall be galvanized completely inside and outside by the hot dip process.
- (b) Materials and minimum nominal sheet thickness shall be in accordance with Table II or equal. Tanks larger than 150-gallon capacity shall be constructed of material not less than the minimum thickness indicated for tanks of 81-150-gallon capacities and the design of such tanks must be suitable for the larger capacity.

312. CONSTRUCTION.

- (a) For maximum strength, cylindrical tanks with convex or concave heads are preferable.
- (b) Tanks of rectangular or specially shaped sections should have rounded edges. Slightly crowned surfaces are recommended.
 - 1. Edges should be rounded to an inside radius of not less than twice the thickness of the bent sheet.
- (c) Tanks with flanged-up top edges, that may trap and hold moisture, shall not be permitted.
- (d) Tanks shall have no openings in bottoms, sides or ends. Openings for fill, vent and feed pipes, and openings for fuel level gages where used, shall be on topmost surface of tanks. Cleanout plates shall not be installed.
- (e) Tanks shall be fitted with a substantial bonding terminal welded or brazed to the tank at the fill pipe connection.

TABLE II.
MINIMUM PLATE THICKNESS FOR GASOLINE FUEL TANKS

MATERIAL	SPECIFICATION	TANK CAPACITIES	
		1 to 80 gal.	81 to 150 gal.
Nickel-copper	B127-49T Class A	.037 in. 20 G	.050 in. 18 G
Copper-nickel	B122-48T Alloy #5	.045 in. 17 G	.057 in. 15 G
Copper	B152-48T Type ETP	.057 in. 15 G	.080 in. 12 G
Copper-Silicon	B97-47T Types A,B,&C	.050 in. 16 G	.064 in. 14 G
Steel sheet		.0747 in. 14 G	.1046 in. 12 G

Note 1. Specifications are those of the American Society for Testing Materials.

Note 2. Gages used above are U. S. Std. for nickel-copper, A. W. G. for copper, copper-nickel and copper-silicon, Mfrs. Standard for steel.

Note 3. No. 18 (U. S. Std.), .050 in nickel-copper is the lightest recommended for metal arc welding.

Note 4. No. 20 (U. S. Std.), .037 in. nickel-copper is only recommended for oxy-acetylene, shielding arc, atomic hydrogen, and electric resistance seam welding, and brazed joints or riveted and brazed joints.

Note 5. No. 22 (U. S. Std.), .031 in. nickel-copper may be used for tanks up to 30 gallons capacity provided they are formed with electric resistance seam welds.

(f) Tank seams shall be joined by one of the following methods:

- (1) Fusion welded-metal arc (See Table II, Note 3). shielded arc, atomic hydrogen, oxy-acetylene.
- (2) Seam welded (Resistance Weld) — Continuous weld nuggets should have 5% to 20% overlap for gasoline-tight joint.
- (3) Brazed — Silver or bronze solders.
- (4) Riveted and brazed — Lap or lock seam with rivets of same composition as metal being joined and external heads and all joints brazed with silver or bronze solder.

(g) Welders employed in the construction of gasoline tanks should be experienced and be capable of producing ductile and pore free welds. It is highly important that welders, resistance welding machines and procedures be qualified at regular intervals to be certain that high quality standards are maintained. Finished welds should be of the same general composition as metal being joined.

(h) Galvanizing of ferrous metal tanks shall be done after fabrication to assure a complete and uniform interior coating free from dirt and dross. This may be accomplished prior to final closure.

(i) Pipe connections shall be threaded spuds, welded or brazed to the tank. Spuds must have sufficient flange area to afford good local reinforcement of tank opening.

(j) Where fuel level gages are used the flange to which gage fittings are attached, shall be welded or brazed to the tank.

(k) Tanks exceeding 18 inches in any horizontal dimension shall be fitted with vertical baffle plates at intervals not exceeding 18 inches.

1. Baffle plate flanges, separate from baffle plates, may be used.

Fire Protection Standards — Continued

2. Baffle shall be of the same material as the tank walls and at least equal in strength.
 3. Flanges shall be bent to an inside radius not less than twice the thickness of the flanged sheet.
 4. Flanges of similar baffle plates shall be of proportionate lengths, and attachments shall be such as to equalize stresses on the tank walls. The aggregate attachment of baffle flanges shall extend not less than 75 per cent of the dimension of the tank wall at the line of contact.
 5. Baffle flanges shall be welded or brazed to tank walls. Baffle plates shall be welded, brazed or riveted to flanges.
- (1) Fuel tanks shall be designed and constructed to withstand an internal pressure of 3 lbs. per sq. in., without deformation or leakage. Each shall be subjected to such a test over a minimum period of 6 hours by the tank manufacturer and should again be similarly tested by the boatbuilder before installation,
- (m) All fuel tanks shall bear a legible, permanent label, located close to the feed pipe spud, signifying compliance with these standards and including the following:
- (1) Manufacturer's name and address.
 - (2) Date of construction.
 - (3) Tank wall thickness in decimals of one inch and capacity in U. S. gallons.
 - (2) Material of construction designated NC (nickel-copper), CN (copper-nickel), C (copper), CS (copper-silicon), and GS (galvanized steel).
313. LOCATION.
- (a) Fuel tanks shall be accessibly located.
 - (b) Fuel tanks shall not be located within living quarters and should be separated therefrom by bulkheads as tight as practicable.
314. INSTALLATION.
- (a) Installation of fuel tanks shall be such as to comply fully with the requirement of accessibility, and to permit examination, testing or removal for cleaning with minimum disturbance to hull structure.
 1. If tank locations are such as to prevent ready inspection of label plates [Para. 312 (m)], small hatches or deck plates shall be provided for that purpose.
 - (b) Tanks shall not be enclosed by sheathing nor shall they be set on tight flooring covering all bottom surface.
 - (c) Flat bottom tanks shall be installed on wooden platforms, slatted to prevent moisture accumulation, and supporting the entire length of the tank.
 - (d) Tanks, other than flat bottom types, shall be set in chocks or cradles, securely fastened to hull structural frame, and of sufficient size and number for proper support. Small tanks may be suspended from deck beams.
 - (e) Adequate support and bracing to prevent any movement of tanks shall be provided. Design of tanks should permit the placing of braces and supports in the same plane with tank baffle plates.
 - (f) All wood or metal surfaces of tank supports and braces shall be effectively insulated from contact with tank surfaces by a non-abrasive and non-absorbent material. Rubber impregnated heavy cotton fabric or acid and oil resistant plastics, are recommended.
 - (g) All fuel tanks shall be electrically bonded to the common ground.
32. FUEL TANKS-Portable type.
322. MATERIALS.
- (a) Tanks should be constructed of corrosion resistant material.
 - (b) Tank wall thickness shall be such that the tank will withstand ordinary rough usage without distortion or leakage of fuel.
323. CONSTRUCTION.
- (a) For maximum strength, curved, concave or convex surfaces should be used.
 - (b) Tank filling arrangements should be such as to provide an expansion space above fuel level of about 5% of tank capacity when tank is fully fueled.
 - (c) The tank vent shall be capable of being closed when tank is not in use.
 - (d) A fuel level gage should be provided on tank to avoid overfilling.
 - (e) Pressure tanks shall be provided with a relief valve set to open at approximately twice the normal operating pressure.
 - (f) Pressure tanks shall be capable of withstanding a pressure test of twice the relief valve setting without leaking or serious permanent distortion.
324. LOCATION.
- (a) Fuel tanks shall be accessibly located in well ventilated spaces outside of enclosed living accommodations.
33. FUEL TANKS-Permanently attached to engines.
331. MATERIALS.
- (a) Tanks permanently attached to engines shall be constructed of corrosion resistant material.
- 332 CONSTRUCTION.
- (a) Tanks shall be so constructed as to withstand normal rough handling without developing leaks.
 - (b) Tanks requiring a vent shall be equipped so that vent may be sealed during periods when engine is removed from boat or when engine is tilted in such a position that fuel may leak from vent.
34. FUEL PIPES & RELATED ACCESSORIES-Where tanks are permanently installed.
- For the purpose of this section *fuel pipes* shall mean all pipe lines, tubing or hose that are conductors of fuel from the deck filling plate to the engine connection. *Related accessories* shall include any attachments to fuel pipes such as valves, strainers, pumps, connecting fittings, etc.
341. GENERAL. — *Where fuel tanks are permanently installed.*
- (a) Fuel pipes shall be accessible. Fuel pipe connections and accessories shall be readily accessible.
 - (b) Fuel pipes shall be adequately secured against excessive movement and vibration.
 - (c) Outlets for drawing gasoline below deck for any purpose shall be prohibited.
 - (d) When making up threaded pipe connections an approved sealing compound, resistant to gasoline, shall be used.
 - (e) When making flared tube connections it is essential that tubing be cut squarely and be truly flared by tools designed for those purposes. Annealing of tube ends before flaring is recommended.
342. MATERIALS. — *Where fuel tanks are permanently installed.*
- (a) Fuel pipes and related accessories shall be of such composition as to be highly resistant to corrosion.
 - (b) Fuel pipes shall be annealed tubing of copper,

Fire Protection Standards — Continued

- nickel-copper or copper-nickel with minimum nominal thickness of .049 inches, except:
1. Wall thickness of filling pipes shall be in accordance with the Iron Pipe Size (I.P.S.) scale.
 2. Where maximum flexibility is necessary a short length of approved flexible tubing especially designed for high resistance to salt water, petroleum oils, heat and vibration may be used.
- (c) Fuel line connections shall be drawn or forged metal of the flared type in accordance with *Specifications for Refrigeration and Marine* of the Society of Automotive Engineers, or of the flared types listed for use with hazardous liquids by Underwriters' Laboratories.
1. Types of connections depending solely on compression against outside of tube for tightness shall not be used.
- (d) Valves shall be of the packless type or equivalent, approved for marine use, and marked or otherwise arranged to indicate open or closed position.
1. Open end cocks of any type shall not be used in fuel lines.
- (e) Strainers shall be of a type approved for marine use with bolted, dogged, bale, or compression gland bonnets.
- (f) Straps for securing fuel pipes must be of a soft metal with no sharp edges.
343. FILL AND VENT PIPES. — *Where fuel tanks are permanently installed.*
- (a) Fill and vent pipes shall be so arranged that overflow of liquid or vapor cannot escape to inside of hull, cabin or coamings and will flow overboard.
 - (b) Fill pipe shall be not less than $1\frac{1}{2}$ inches I.P.S. It shall be made tight to tank top and to deck plate located outside of coaming.
 1. Fill pipe should run as directly as possible, preferably in a straight line from deck plate or other closable plate to tank top spud and may extend to near bottom of tank provided it is suitably supported.
 2. Fuel fill shall be identified by the marking "FUEL" on the deck plate flange.
 - (c) Where a flexible fill pipe section is necessary, an approved metallic type is recommended. When a non-metallic section is used, it shall be in accordance with Para. 342(b)2. Such hose must overlap metallic pipe ends at least $1\frac{1}{2}$ times the pipe diameter. It shall be tightly secured at each end by two suitable clamps of corrosion-resistant metal. Flexible section shall be accessible and as near the upper end of the filling pipe as practicable.
 1. When the flexible section is a non-conductor of electricity the metallic sections separated thereby shall be joined by a conductor for protection against static spark when filling.
 - (d) When, because of offset, sounding of tanks through fill pipes is impossible, other methods of indicating fuel level must be used provided Para. 312 (d) is complied with and provided they are so arranged as not to expose the liquid or vapor in cabin, cockpit, or underdeck, or to permit vapor to drift below.
 - (e) Vent pipe termination should be as remote as practicable from any hull opening. The discharge end of the vent pipe shall have provisions preventing intake of water without restricting the continuous
- (f) Vent pipe connection shall be from highest point of tank as installed in boat, under conditions of normal trim.
 1. Vent pipe shall not be tapped into the fill pipe.
 - (g) Vent pipe shall be not less than $\frac{5}{8}$ -inch O. D. copper tubing. If fill pipe extends to near tank bottom the vent pipe should be not less than $\frac{3}{4}$ -inch O. D. copper tubing.
 - (h) Vent pipe outlets shall have removable flame arresters as protection against flash-back from outside source of ignition and arrester screens should be kept clear by cleaning or renewal as necessary. Any device used must not reduce net vent area.
344. FUEL FEED LINES AND ACCESSORIES. — *Where fuel tanks are permanently installed.*
- (a) Engine-driven mechanical fuel systems shall be used except that independent electric pump systems may be used provided they are energized only when engine ignition is on.
 - (b) Fuel lines shall be run with as few connections as practicable and shall be protected from mechanical injury.
 1. It is recommended that the fuel line be run at the level of tank top to a point as close to the engine connection as practicable.
 - (c) A shut-off valve shall be installed to close against fuel flow directly at the tank connection. Arrangement shall be provided for operating this valve from outside the compartment in which tanks are located, preferably from above deck.
 1. A service stop-valve shall be installed at engine end of fuel line to stop fuel flow when servicing accessories.
 - (d) That part of the fuel feed line secured to hull members shall be separated from that part secured to the engine by a short length of approved metallic-reinforced flexible tubing with approved connection fittings. This flexible connection shall meet the requirements of Para. 342 (b) 2 and should maintain metallic contact between the sections of the fuel feed line connected. If such contact is not maintained the fuel tank shall be specifically grounded.
 - (e) All accessories, not including fittings, installed in the fuel line shall be independently supported.
35. FUEL LINES AND RELATED ACCESSORIES. - *For portable tanks.*
- For the purpose of this section, the term *fuel lines* means the flexible lines connecting the portable tank to the engine and the term *related accessories* includes "quick connectors" at the engine or tank.
351. MATERIALS. — *Where tanks are portable.*
- (a) All fuel lines shall be flexible so as to coil readily at temperatures from $-20^{\circ}\text{F}.$ to $140^{\circ}\text{F}.$
 - (b) Fuel lines shall be of material resistant to petroleum products, fresh and salt water, and direct sunlight.
 - (c) All metallic parts shall be corrosion resistant.
352. CONSTRUCTION. — *Where tanks are portable.*
- (a) All fuel line connectors should be of the self-sealing type on the side leading to the tank.
 - (b) Arrangements should be provided so that the operation of making or breaking a connection can be accomplished with a minimum of spillage and such spillage drained overboard.

Fire Protection Standards — Continued

- (f) All component parts of systems other than cylinders and low pressure distribution tubing between regulators and appliances shall be listed by Underwriters' Laboratories, Inc., or other recognized testing laboratory and so labeled.
- (g) All component parts of systems, except cylinders, appliances and low pressure tubing, shall be designed to withstand a pressure of 500 pounds per square inch gage without rupture.
- (h) With each liquefied petroleum gas system installed on a boat, two of the signs required by Para. 411 shall be provided. These signs shall include:

CAUTION

1. Keep cylinder valves closed when boat is unattended. Close them immediately in any emergency.

2. Be sure all appliance valves are closed before opening cylinder valve.

3. Always apply match or flame to burner and then open burner valve.

4. Close master valve whenever consuming appliance is not in use.

5. Test system for leakage at least bi-weekly, and after any emergency in accordance with the following procedure:

With appliance valves closed, the master shut-off valve on the appliance open, and with one cylinder valve open, note pressure on the gage. Close cylinder valve. The pressure should remain constant for at least 10 minutes. If pressure drops, locate leakage by application of liquid detergent or soapy water solution at all connections. Never use flame to check for leaks. Repeat test for each cylinder in multi-cylinder system.

- (i) The required caution signs shall be installed in plainly visible locations on the outside of the cylinder enclosure and adjacent to the consuming appliance.

422. CYLINDERS.

- (a) Cylinders shall be constructed, tested, marked, maintained, and retested in accordance with the regulations of the Interstate Commerce Commission.
- (b) Cylinder markings shall include the following: ICC specification symbol, under which the cylinder was fabricated, followed by the designed service pressure in pounds, — the serial number and identifying symbol (letters), — the minimum water capacity in pounds, — the tare weight in pounds (including all attached fittings but not including the protective cap), — and the dates (month and year) when the cylinder was tested.
- (c) Prescribed cylinder markings shall be maintained in a legible condition. Cylinders shall be maintained free from corrosion and properly painted for such protection.
- (d) If on account of painting or any other reason, the prescribed cylinder markings cannot be kept plain and legible, a metal plate brazed, soldered or otherwise securely fastened to the cylinder, with a reproduction of the said markings plainly stamped thereon, may be permitted.
- (e) Each cylinder shall bear a test date marking, indicating that it has been tested within the past five years.
- (f) Regardless of the date of the previous test, a cylinder must be condemned and withdrawn from service when it leaks; when corrosion, denting, bulging or other evidence of rough usage exists to the extent that the cylinder is likely to be weakened appreciably; when it has lost more than 5 percent of its tare weight, or when it has been involved in a fire.

423. VALVES AND SAFETY RELIEF DEVICES.

- (a) Each cylinder shall have a manually operated shut-off valve installed directly at the cylinder outlet, equipped with a securely attached hand wheel for convenient operation without the use of a separate wrench.
- (b) All cylinders shall be equipped with safety relief devices, approved by the Bureau of Explosives and found to prevent explosion of the normally charged cylinder when it is placed in a fire. These devices shall be a shut-off valve with integral spring-loaded safety relief valve and a supplementary fusible plug, the latter designed to yield when the cylinder has been emptied of *liquid* gas by the relief valve under over-heat condition.
- (c) Cylinder valves and safety relief devices shall have direct communication with the vapor space of the cylinder.
- (d) In addition to the valve required at the cylinder, a multi-cylinder system shall be provided with a two-way positive shut-off manifold valve of manually operated type.
- (e) Discharge of the safety relief valves shall be vented away from the cylinder, insofar as practicable, upward into the open atmosphere, but in all cases so as to prevent impingement of escaping gas onto a cylinder.

424. REDUCING-REGULATOR.

- (a) All systems shall be provided with a regulating device, so adjusted as to release gas to the distributing tubing at a pressure not in excess of 18 inches water column, approximately .653 pounds per square inch gage.
- (b) A low pressure relief valve shall be integral with the regulator; it shall be set to start to discharge at not less than two times and not more than three times the delivery pressure.
- (c) The relief valve and the space above regulator and relief valve diaphragms may be vented to the atmosphere through a common outlet. This outlet should be vented to a point at least two feet distant (and farther if possible) from any part of an opening to the cabin or hull interior or from an engine exhaust which is below the level of such discharge.
- (d) Outlet terminations shall be turned downward to prevent water entering the discharge line.
- (e) All reducing-regulators shall be fitted with a pressure gage. This gage shall be on the high pressure side of the regulator. The purpose of the pressure gage is to provide a convenient and quick means of testing the system, from the cylinder valve to and including the appliance valves, for leakage. It is recommended that this test be made at least bi-weekly and after any emergency. No leakage, even of a seeping character, should be tolerated.

425. PIPING AND FITTING.

- (a) All low pressure distribution tubing between regulator and appliances shall be copper tubing of the standard grade K or L or equivalent and shall have a minimum wall thickness of .032 inches. All high pressure tubing between cylinders and regulators shall have a minimum wall thickness of .049 inches.
- (b) Tube connecting fittings shall be of drawn or forged yellow metal, of flared type, listed for use with gas or hazardous liquids by Underwriters' Laboratories,

Fire Protection Standards — Continued

- (f) All component parts of systems other than cylinders and low pressure distribution tubing between regulators and appliances shall be listed by Underwriters' Laboratories, Inc., or other recognized testing laboratory and so labeled.
- (g) All component parts of systems, except cylinders, appliances and low pressure tubing, shall be designed to withstand a pressure of 500 pounds per square inch gage without rupture.
- (h) With each liquefied petroleum gas system installed on a boat, two of the signs required by Para. 411 shall be provided. These signs shall include:

CAUTION

- 1. Keep cylinder valves closed when boat is unattended. Close them immediately in any emergency.
- 2. Be sure all appliance valves are closed before opening cylinder valve.
- 3. Always apply match or flame to burner and then open burner valve.
- 4. Close master valve whenever consuming appliance is not in use.
- 5. Test system for leakage at least bi-weekly and after any emergency in accordance with the following procedure:

With appliance valves closed, the master shut-off valve on the appliance open, and with one cylinder valve open, note pressure on the gage. Close cylinder valve. The pressure should remain constant for at least 10 minutes. If pressure drops, locate leakage by application of liquid detergent or soapy water solution at all connections. Never use flame to check for leaks. Repeat test for each cylinder in multi-cylinder system.

- (i) The required caution signs shall be installed in plainly visible locations on the outside of the cylinder enclosure and adjacent to the consuming appliance.

422. CYLINDERS.

- (a) Cylinders shall be constructed, tested, marked, maintained, and retested in accordance with the regulations of the Interstate Commerce Commission.
- (b) Cylinder markings shall include the following: ICC specification symbol, under which the cylinder was fabricated, followed by the designed service pressure in pounds, — the serial number and identifying symbol (letters), — the minimum water capacity in pounds, — the tare weight in pounds (including all attached fittings but not including the protective cap), — and the dates (month and year) when the cylinder was tested.
- (c) Prescribed cylinder markings shall be maintained in a legible condition. Cylinders shall be maintained free from corrosion and properly painted for such protection.
- (d) If on account of painting or any other reason, the prescribed cylinder markings cannot be kept plain and legible, a metal plate brazed, soldered or otherwise securely fastened to the cylinder, with a reproduction of the said markings plainly stamped thereon, may be permitted.
- (e) Each cylinder shall bear a test date marking, indicating that it has been tested within the past five years.
- (f) Regardless of the date of the previous test, a cylinder must be condemned and withdrawn from service when it leaks; when corrosion, denting, bulging or other evidence of rough usage exists to the extent that the cylinder is likely to be weakened appreciably; when it has lost more than 5 percent of its tare weight, or when it has been involved in a fire.

423. VALVES AND SAFETY RELIEF DEVICES.

- (a) Each cylinder shall have a manually operated shut-off valve installed directly at the cylinder outlet, equipped with a securely attached hand wheel for convenient operation without the use of a separate wrench.
- (b) All cylinders shall be equipped with safety relief devices, approved by the Bureau of Explosives and found to prevent explosion of the normally charged cylinder when it is placed in a fire. These devices shall be a shut-off valve with integral springloaded safety relief valve and a supplementary fusible plug, the latter designed to yield when the cylinder has been emptied of liquid gas by the relief valve under over-heat condition.
- (c) Cylinder valves and safety relief devices shall have direct communication with the vapor space of the cylinder.
- (d) In addition to the valve required at the cylinder, a multi-cylinder system shall be provided with a two-way positive shut-off manifold valve of manually operated type.
- (e) Discharge of the safety relief valves shall be vented away from the cylinder, insofar as practicable, upward into the open atmosphere, but in all cases so as to prevent impingement of escaping gas onto a cylinder.

424. REDUCING-REGULATOR.

- (a) All systems shall be provided with a regulating device, so adjusted as to release gas to the distributing tubing at a pressure not in excess of 18 inches water column, approximately .653 pounds per square inch gage.
- (b) A low pressure relief valve shall be integral with the regulator; it shall be set to start discharge at not less than two times and not more than three times the delivery pressure.
- (c) The relief valve and the space above regulator and relief valve diaphragms may be vented to the atmosphere through a common outlet. This outlet should be vented to a point at least two feet distant (and farther if possible) from any part of an opening to the cabin or hull interior or from an engine exhaust which is below the level of such discharge.
- (d) Outlet terminations shall be turned downward to prevent water entering the discharge line.
- (e) All reducing-regulators shall be fitted with a pressure gage. This gage shall be on the high pressure side of the regulator. The purpose of the pressure gage is to provide a convenient and quick means of testing the system, from the cylinder valve to and including the appliance valves, for leakage. It is recommended that this test be made at least bi-weekly and after any emergency. No leakage, even of a seeping character, should be tolerated.

425. PIPING AND FITTING.

- (a) All low pressure distribution tubing between regulator and appliances shall be copper tubing of the standard grade K or L or equivalent and shall have a minimum wall thickness of .032 inches. All high pressure tubing between cylinders and regulators shall have a minimum wall thickness of .049 inches.
- (b) Tube connecting fittings shall be of drawn or forged yellow metal, of flared type, listed for use with gas or hazardous liquids by Underwriters' Laboratories,

Fire Protection Standards — Continued

Inc., or other recognized testing laboratory; or connections may be soldered or brazed with a material having a melting point in excess of 1000°F.

426. APPLIANCES.

- (a) All gas consuming appliances shall have their correctness as to design, construction and performance, in liquefied petroleum gas service, certified as follows:
 1. Determined by a nationally recognized testing agency, adequately equipped and competent to perform such services, which shall be evidenced by the attachment of its seal or label to such gas appliances. This agency shall be one which maintains a program of national inspection of production models of gas appliances at least yearly on the manufacturer's premises. Approval by the American Gas Association Laboratories, as evidenced by the attachment of its Listing Symbol or Approval Seal to gas appliances and a certificate or letter certifying under the above mentioned requirements, or Listing by Underwriters' Laboratories, shall be considered as constituting compliance with the provisions of this section.
 2. Such appliances must also be approved for *marine use* by the authority having jurisdiction and comply with applicable parts of Section 411.
- (b) A master packless shut-off valve, controlling all burners simultaneously, is required at the manifold of all appliances.
- (c) Cooking stoves, domestic hot water heaters and cabin space heaters shall comply with the applicable provisions of Sections 41-43.
 1. Continuous burning pilot flames are not approved for use on any gas burning appliance when installed below the main deck.
 2. Refrigerating machines operated by flame shall not be used.
- (d) Gas-fired cabin space heaters shall be of the sealed combustion type, full vented to the outside atmosphere, and with combustion air take from outside the hull and cabin.
 1. Open flame gas heaters shall not be used.

427. LOCATION AND INSTALLATION.

- (a) Cylinders, regulating and safety equipment shall be substantially secured, readily accessible, and so located that vapor escaping from any cause cannot reach the bilges, machinery space, accommodations or other enclosed spaces.
 1. Such locations are confined to open deck, or cabin top, outside of cockpits or semi-enclosures and equipment so placed shall be protected from climatic extremes by a housing vented to open air near the top and bottom.
 2. If construction or design prevents compliance with the locations specified above, the cylinder, regulating and safety equipment may be mounted in a vapor tight container located above the waterline in an open cockpit provided the container:
 - (1) Is constructed of corrosion resistant metal.
 - (2) Opens only from the top, with cover seated on gasket and tightly latched but so as to be conveniently and quickly opened for operation of cylinder valves and testing of system for leakage.

- (3) Is vented at the bottom by a pipe of at least 1/2 inch I.D., led outboard without pockets through the hull sides to a point lower than the container bottom but above the water line.
- 3. Stowage of high pressure equipment in housings shall be such that the cylinder valves can be conveniently and quickly operated and the pressure gage dial must be fully visible.
- 4. Housings shall not be used for storage of any other equipment nor shall quick access to the high pressure system be obstructed in any way.
- (b) Stowage provisions for unconnected reserve cylinders, filled or empty, shall be the same as the provisions above for cylinders in use. Valves of cylinders, even those considered empty, shall be kept tightly closed.
- (c) Distribution lines shall be protected from physical damage and be readily accessible for inspection.
 1. Lines shall be substantially secured against vibration by neat fitting soft non-ferrous metal clips with no sharp edges in contact with the tubing.
 2. Lines shall be protected by close fitting ferrules of non-abrasive material wherever they pass through decks or bulk-heads, and where passing through decks the connections shall be vapor-tight.
 3. Lines shall be continuous lengths of tubing from regulator to shut-off at stove manifold.
- (d) After installation, distribution tubing shall be tested prior to its connection to regulator and appliance by an air pressure of not less than 5 pounds per square inch gage. After this test the distribution tubing shall be connected to the regulator and appliance and the whole system subjected to the following test: With appliance valves closed, the master shut-off valve on the appliance open, and with one cylinder valve open, note the pressure on the gage. Close cylinder valve. Pressure should remain constant for at least 10 minutes. If pressure drops, locate leakage by application of liquid detergent or soapy water solution at all connections. Never use flame to check for leaks.

428. PRECAUTIONS

- (a) A cylinder shall not be charged with a gas whose vapor pressure at 130°F. exceeds the registered service pressure of the cylinder by more than 20 percent.
- (b) A cylinder shall not be charged with fuel unless it bears the proper markings of the code under which it was fabricated, and also its minimum water content and tare weight in pounds.
- (c) If a cylinder is due to be retested, it shall not be charged with fuel until it has been retested and otherwise maintained in accordance with regulations of the Interstate Commerce Commission.
- (d) Retests shall be of the hydrostatic type, in a water-jacket, at two times the service pressure, with testing equipment and method approved by the Bureau of Explosives. This is the responsibility of the owner of the cylinder at times of testing.
- (e) Cylinder valves and safety devices must be tested for leaks before the charged cylinder is shipped from the cylinder filling plant and it shall not be shipped with leaking fittings.
- (f) Charging of cylinders shall be such that the liquid gas will not completely fill the cylinder at a temperature of 130°F.
- (g) The vapor pressure in the cylinder at 70°F. must not exceed the service pressure for which the cylinder was designed.
- (h) Safety relief valves should be tested at five year intervals.

F/re Protection Standards—Continued

43. HEATING EQUIPMENT.

431. SERVICE HOT WATER HEATING UNITS.
 - (a) Open flame heating units shall be installed within the galley area, well above accommodation flooring and in compliance with applicable provisions of Sections 41 and 42.
 - (b) Vent stacks should be fitted at the top of heating units and led outboard through the deck with an effective integral attachment for preventing flame extinguishment or flareback from back draft.
 1. Dampers shall not be installed in vent stacks.
 - (c) Continuous burning or pilot flames shall not be permitted under deck.
432. CABIN HEATERS.
 - (a) Cabin heating equipment shall comply with applicable provisions of Sections 41 and 42.
 1. Bubble feed or wick type burners shall not be used for any fuel.
 2. Portable heaters shall not be used.
 3. Continuous burning or pilot flames shall not be used under deck.
 4. Gasoline shall not be used for fuel in open flame liquid or vapor burners.
 - (b) Hot water heating boilers shall be of types approved by the U. S. Coast Guard.
 - (c) Sealed combustion chamber heaters burning gasoline or fuel oil may be used provided they comply with Para. 411.
 1. Installation of this type heater shall be in accordance with approved standards which the manufacturer shall include in the required instructions covering installation, operation and maintenance.

44. AUXILIARY APPLIANCES.

441. LAMPS AND LANTERNS.

- (a) Oil lamps and lanterns shall be of types approved for marine use.
 1. Gasoline shall not be used for fuel.
- (b) Oil lamps shall have metal bodies and be hung in gimbals.
 1. Oil lamps shall not be located directly over galley stoves or heating units.
 2. Metal shields shall be secured above chimneys.
- (c) Oil lanterns, when suspended, shall be secured by clips or lashings.
 1. Lanterns not in use should be stowed in a metal lined locker.

442. ICE MACHINES.

- (a) Electric machines should have motors located on top of cabinets, or if separate from cabinets, well above bilges.
 1. Wiring shall be in accordance with Chapter 5.

CHAPTER 5. ELECTRICAL SYSTEMS

50. This chapter refers specifically to electrical installations operating at potentials under 50 volts. Those operating at potentials of 50 volts and over shall be in accordance with Electrical Engineering Regulations of the U. S. Coast Guard (CG-259).

It is to be recognized that low voltage installations do not warrant the use of substandard materials or work-

manship, particularly in motorcraft where the possible presence of flammable or explosive vapors renders a spark or incandescence from a physical failure liable to serious consequences.

Class I Hazardous Locations as used in this Chapter means locations in which flammable gases or vapors are or may be present in the air in quantities sufficient to produce explosive or ignitable mixtures. This definition is in accordance with the *National Electrical Code*.

51. GENERAL. The battery used to start main engine may also be used for other purposes when hand emergency starting is provided.

511. The system supply voltage should be determined by the maximum electrical load including consideration for the length of electrical conductors.

- (a) In designing the electrical system, the inclusion of spare circuits of sufficient capacity to permit the addition of ordinary accessories is recommended.
- (b) Circuits added to accommodate additional electrical accessories shall comply with Paragraph 522 (b).

512. Batteries shall not be tapped for voltages other than the total voltage of all the cells comprising the battery.

513. Each accessory shall be provided with a name plate indicating the maker's name, the rating in volts and amperes or in volts and watts, and when intended for connection to a normally grounded supply, the grounding polarity.

52. EQUIPMENT.

521. Generators and motors shall be placed in dry, accessible and adequately ventilated locations.

- (a) Independent generators and motors should be mounted on foundations as high as practicable above the bilges to avoid damage by splash or contact with low lying vapors. They shall not be located in low or pocketed positions.
- (b) Generators and motors suitable for use in Class I hazardous locations are recommended.
- (c) All generators shall be protected from excessive current by circuit breakers or fuses.
- (d) Overcurrent protection of a third-brush type generator shall open the field circuit.
- (e) An emergency switch shall be provided in the normally ungrounded main supply conductor and shall be located as closely as practicable to the supply battery.

522. Switchboards shall be placed in dry, accessible and adequately ventilated locations, preferably outside the engine compartment. Switchboards shall be metal enclosures and have provision for access to interior. All uninsulated current carrying parts shall be mounted on non-absorbent non-combustible, high dielectric insulating material.

- (a) Totally enclosed switchboards of the dead front type are recommended. Wood is not considered acceptable for the enclosure.
- (b) Each conductor of circuit supplying lights, motors or appliances shall be equipped with a circuit breaker or switch and fuses at the point of attachment to the power source.
- (c) Switches other than those mounted on the switchboard shall be of the enclosed type.
- (d) If the storage battery is not in the same compartment and adjacent to the panel or box which distributes

Fire Protection Standards — Continued

542. Wiring joints and splices shall be mechanically secure.

- (a) Unless a splice is made by an insulated pressure wire connector, listed by Underwriters' Laboratories, Inc., it shall be thoroughly soldered, taped first with rubber and then with friction tape to afford insulation equivalent to that of the conductors joined.
- (b) Where ends of stranded conductors are to be clamped under terminal screws, they shall be formed and soldered unless fitted with pressure terminal connectors listed by Underwriters' Laboratories.

543. Conductors shall be protected in accordance with their current-carrying capacities as given in TABLE III.

TABLE III.
**ALLOWABLE CURRENT-CARRYING CAPACITIES
OF CONDUCTORS.**

BASED ON ROOM TEMP. OF 30°C., 86°F.

Size (See National Electrical Code for other sizes.)		Capacity of Wire in Amperes	
Gage No. A. W. G.	Area in Circular Mills	Rubber Insulated Types R, RW, RI (Sizes 12-6)	Rubber Insulated Type RH
14	4107	15	15
12	6530	20	20
10	10380	30	30
8	16510	40	45
6	26250	55	65
4	41740	70	85
3	52630	80	100
2	66370	95	115
1	83690	110	130

1 Mil = 0.001 Inch Circular Mil Area = Diameter²

NOTES : The current-carrying capacities listed above are for 1, 2, and 3 conductor cables; 80% of these capacities must be used for 4, 5, and 6 conductor cables, and 70% for 7, 8, and 9 conductor cables.

The allowable current-carrying capacities in this table are based on temperature alone and do not take voltage drop into consideration.

NOTE: Overcurrent protection for conductors is provided for the purpose of opening the electric circuit if the current reaches a value which will cause an excessive or dangerous temperature in the conductor or conductor insulation.

- (a) The conductors supplying motors and motor-operated appliances shall be protected by a separate overcurrent device which is responsive to motor current. This device shall be rated or set at not more than 125 per cent of the motor full-load current rating for an open type motor marked to have a temperature rise not over 40°C and not more than 115 per cent for all other types of motors.
- (b) Concealed wiring may be unprotected, but shall be secured by neat fitting non-ferrous cleats with rounded edges spaced not over 14 inches apart.
- (c) Where it is necessary for wiring to pass through structural members, it shall be adequately protected.

TABLE IV.
CONDUCTOR SIZES FOR AMPERES-LENGTHS.

Total Current on Circuit in Amps.	Length of Conductor in Feet from Source of Current to Most Distant Fixture										
	10	15	20	25	30	35	40	45	50	55	60
6 Volts Two Wire - 10% Drop Wire Sizes (A. W. G.)											
5	14	14	14	12	12	12	10	10	10	10	8
10	14	12	10	10	8	8	8	8	6	6	6
15	12	10	8	8	8	6	6	6	4	4	4
20	10	8	8	6	6	6	4	4	4	4	3
25	10	8	6	6	4	4	4	4	3	3	2
12 Volts Two Wire - 10% Drop Wire Sizes (A. W. G.)											
5	14	14	14	14	14	14	14	14	12	12	12
10	14	14	14	12	12	12	10	10	10	10	8
15	14	14	12	10	10	10	8	8	8	8	8
20	12	10	10	8	8	8	8	8	6	6	6
25	10	10	10	8	8	8	6	6	6	6	4

TABLE V.
CONDUCTOR

Type Letter*	Trade Name	Insulation	Thickness of Insulation		Outer Covering	Max. Oper-ating Temp.	Special Provisions
R	Code	Code-Rubber	14-12 10 8-2 1	2/64 In. 3/64 In. 4/64 In. 5/64 In.	Moisture-Resistant, Flame-Retardant, Fibrous Covering	60°C. 140°F.	General Use
RW	Moisture-Resistant	Moisture-Resistant Rubber	14-10 8-2 1	3/64 In. 4/64 In. 5/64 In.	Moisture-Resistant, Flame-Retardant, Fibrous Covering	60°C. 140°F.	General Use and Wet Locations
RU	Latex	90% Unmilled Grainless Rubber	14-10 8-6	18 Mils 25 Mils	Moisture-Resistant, Flame-Retardant, Fibrous Covering	60°C. 140°F.	General Use
RH	Heat-Resistant	Heat-Resistant Rubber	14-12 10 8-2 1	2/64 In. 3/64 In. 4/64 In. 5/64 In.	Moisture-Resistant, Flame-Retardant, Fibrous Covering	75°C. 167°F.	General Use
T	Thermoplastic	Flame-Resistant Thermoplastic Compound	14-10 8 6-2 1	2/64 In. 3/64 In. 4/64 In. 5/64 In.	None	60°C. 140°F.	General Use
TW	Moisture-Resistant Thermoplastic	Flame-Resistant, Moisture-Resistant Thermoplastic	14-10 8 6-2 1	2/64 In. 3/64 In. 4/64 In. 5/64 In.	None	60°C. 140°F.	General Use and Wet Locations

*See National Electrical Code

Fire Protection Standards — Continued

TABLE VI.
FLEXIBLE CORDS.

Type* Letter*	Trade Name	Size A. W. G.	No. of Conductors	Conductor Insulation	Outer Covering	Use
S	Hard Service Cord	18 to 10 incl.	2 or More	Rubber Thermo- plastic	Rubber	Pendant or Portable
SO					Oil- Resistant Compound	Damp Places— Extra Hard Usage
ST					Thermo- plastic	

TABLE VII.
**ALLOWABLE CURRENT-CARRYING CAPACITY
OF FLEXIBLE CORD.**

Size A. W. G.	Amperes
18	7
16	10
14	15
12	20
10	25

544. Where metal enclosures of electrical equipment are conductively connected to one side of the supply circuit, the conductor employed shall be identified throughout the wiring system. The identified conductor shall be connected to the terminal of the same polarity at each source of supply.

(a) Appliances shall be connected to supply circuits so as to maintain polarity throughout the system to insure against short circuiting.

545. On wooden boats, bonding together of all metal enclosures, frames and supports of electrical equipment including battery trays to a common ground is necessary to guard against the effects of electrolysis.

- (a) The negative terminal is recommended for the grounding polarity.
- (b) Where a ground plate is provided for radio equipment it shall have at least 12 square feet of exposed surface and be connected to the common bonding conductor.

CHAPTER 6

FIRE EXTINGUISHING EQUIPMENT*

60. INTRODUCTORY INFORMATION.

601. CLASSIFICATION OF FIRES. For all practical purposes there are three general classes of fires:

Class "A" fires, defined as fires in ordinary combustible materials such as wood, cloth and paper where the "quenching-cooling" effect of quantities of water or solutions containing large percentages of water is most effective in reducing the temperature of the burning material below the ignition temperature and is, therefore, of first importance.

*Published in National Fire Codes, Vol. IV and in separate pamphlet form by the National Fire Protection Association.

Class "B" fires, defined as fires in flammable petroleum products or other flammable liquids, greases, etc. where the "blanketing-smothering" effect of oxygen-excluding media is most effective.

Class "C" fires, defined as fires involving electrical equipment where the electrical nonconductivity of the extinguishing media is of first importance.

602. CLASSIFICATION OF FIRE EXTINGUISHERS: Based upon the preceding classification of fires and also upon fire extinguishment potentials as determined by physical testing of fire extinguishers by Underwriters' Laboratories, Inc., classifications have been established for first aid fire extinguishing appliances. This classification consists of a **Numerical and a Letter**. It appears on the label affixed to the appliances labeled by Underwriters' Laboratories, Inc., and Underwriters' Laboratories of Canada. This **Numerical and Letter** connote the following:

(a) In the case of Class "A" appliances, the **Numerical** is indicative of the approximate relative fire extinguishing potential of various size Class "A" fire appliances, i.e., a 4-A appliance can be expected to extinguish approximately twice as much fire as a 2-A appliance.

TABLE VIII.
FIRE EXTINGUISHERS.

Type* of Extingui- shers	Flame Suitable			Extinguishing Agent	Sublet to Fr*eing	Annual Required*	Operating Precaution*
	"A"	"B"	"C"				
SODA- ACID	Y e s	N o	N o	Water and products of sodium, bicarbonate, and sulfuric acid reaction.	Yes	Discharge, refill and tag.	Do not use on live electrical equipment.
ANTI- FREEZE		Y e s	N o	Water solution of calcium chloride and corrosion inhibitor.	No	Weigh cartridge, replenish solution and tag.	Do not use on live electrical equipment.
LOADED STREAM		Y e s	Y e s	Water solution of alkali-metal salt.	No	Weigh cartridge and tag.	Do not use on live electrical equipment.
FOAM	Y e s		Y e s	Foam from reaction of aluminum sulfate and sodium bicarbonate with added foam stabilizer.	Yes	Discharge, refill and tag.	Do not use on live electrical equipment.
VAPORIZING LIQUID**	N o	Y e s		Specially treated carbon tetrachloride or chlorthane.	No	Partly discharge, refill, and tag.	Avoid exposure to fire fumes. Maintain ventilation where used.
CARBON DIOXIDE***	N o		Y e s	Carbon dioxide.	No	Weigh and tag.	Smothering in high concentrations. Avoid contact with discharge horn.
DRY CHEMICAL**	N o	Y e s		Specially treated sodium bicarbonate.	No	Weigh cartridge and tag.	None.

*May be useful in controlling small Class "A" surface fires.

- (b) In the case of Class "B" appliances, the **Numerical** is also indicative of the approximate relative fire extinguishing potential of various size Class "B" fire appliances, and in addition, the **Numerical** is an approximate indication of the square-foot area of deep-layer flammable liquid fire which an average operator can extinguish, i.e., a 10-B unit can be expected to extinguish 10 square feet of deep layer flammable liquid fire when used by an average operator.
- (c) In the case of Class "C" appliances, no **Numerical** is used since Class "C" fires are essentially either Class

*More detailed information on portable fire extinguishers may be found in the *Standards for the Installation, Maintenance and Use of Portable Fire Extinguishers* (NFPA No. 10) Published in National Fire Codes, Vol. IV and in separate pamphlet form by the National Fire Protection Association.

Fire Protection Standards — Continued

"A" or "B" fires involving energized electrical wiring and equipment. The size of the Class "C" appliance installed should be commensurate with the size and extent of the area involving the electrical hazard or containing equipment being protected, considering that it must be covered or blanketed by the Class "C" extinguishing media for effective fire extinguishment.

- (d) The Letter refers to the class of fire (see Paragraph 601 preceding) on which the use of the particular appliance is approved for most effective fire extinguishment.

TABLE IX.
CONVERSION TABLE FOR CLASSIFICATION OF FIRE EXTINGUISHERS

The method of classifying extinguishers used in the 1955 and earlier Editions of NFPA No. 10 differs from the presently described method. The object of this Table is to indicate an approximate conversion from the old to the new method of classifying portable fire extinguishers. Since an accurate reclassification of extinguishers already in service and labeled under the old system of classification cannot be determined except by actual fire tests, only approximate conversion classifications can be given.

CLASSIFICATION OF FIRE EXTINGUISHERS.

	Extinguisher Type and Size	Classifications Under Old Method	Approximate Classifications Under Present Method
Chemical Solution (soda-acid)	11/4, 1/2-gallon	A-2	1-A
	21/2-gallon	A-1	2-A
	17-gallon	A	10-A
	33-gallon	A	20-A
Water	1 ^{1/2} 1 ^{3/4} -gallon (pump or pressure)	A-2	1-A
	2 ^{1/2} -gallon (pump or pressure)	A-1	2-A
	4-gallon (pump or pressure)	A-1	3-A
	A-1 5-gallon (pump pressure)	A-1	4-A
	17-gallon (pressure) ..A	A	10-A
	33-gallon (pressure) ..A	A	20-A
	6 10-quart pails and 25-gallon cask (minimum)	A-1	2-A
Loaded Stream ,	1-gallon	A-2JB-4	1-A
	13/4-gallon	A-1,B-2	2-A,y ₂ -B
	21/2-gallon	A-1,B-2	2-A, 1/2-B
	33-gallon	A	20-A
Foam	1/4-gallon	A-2,B-2	1-A,2-B
	1/2-gallon	A-2,B-2	1-A,2-B
	21/2-gallon	A-1,B-1	2-A,4-B
	5-gallon	A-1,B-1	4-A,6-B
	10-gallon	A,B	6-A,8-B
	17-gallon	A,B	10-A,10-B
	33-gallon	A,B	20-A,20-B
Vaporizing Liquid carbon tetrachloride base)	1, 11/4, 1/2-quart pump)	B-2,C-2	1/2-B,C
	1, 11/2, 2, 21/2-quart (pressure)	B-2,C-2	1/2-B,C
	31 ^{1/2} -gallon (pressure) ..	B-2,C-1	1-B,C
	1-gallon (pressure) ..	B-2,C-1	1-B,C
Vaporizing Liquid (chlorobromo-methane)	1 and 11/2-quart (pressure)	B-2,C-1	1-B,C
	1-gallon (pressure) ..	B-2,C-1	2-B,C
Carbon Dioxide,	6 or less pounds of carbon dioxide.....	B-2,C-2	1-B,C
	2 pounds of carbon dioxide.....	B-2,C-1	2-B,C
	10 pounds of carbon dioxide	B-2,C-1	4-B,C
	12 pounds of carbon dioxide	B-2,C-1	4-B,C
	15 and 18 pounds of carbon dioxide.....	B-1,C-1	4-B,C
	20 pounds of carbon dioxide	B-1,C-1	4-B,C
	25 and 26 pounds of carbon dioxide.....	B-1,C-1	6-B,C
	NOTE: Carbon dioxide, extinguishers with metallic horns will not carry any C classification.		

TABLE IX (Continued)
CONVERSION TABLE FOR CLASSIFICATION OF FIRE EXTINGUISHERS

Extinguisher Type and Size	Classifications Under Old Method	Approximate Classifications Under Present Method
50 pounds of carbon dioxide	B-1,C-1	10-B,C
75 pounds of carbon dioxide	B-1,C-1	12-B,C
100 pounds of carbon dioxide	B,C	12-B,C
Dry Chemical		
.6 H or less pounds of dry chemical	B-2,C-2	4-B,C
1 ^{1/4} pounds of dry chemical	B-2,C-1	6-B,C
10 pounds of dry chemical	B-1,C-1	8-B,C
12 pounds of dry chemical	B-1,C-1	8-B,C
15 pounds of dry chemical	B-1,C-1	8-B,C
20 pounds of dry chemical	B-1,C-1	16-B,C
30 pounds of dry chemical	B-1,C-1	20-B,C
75 pounds of dry chemical	B,C	40-B,C
150 pounds of dry chemical	B,C	40-B,C
300 and 350 pounds of dry chemical	B,C	40-B,C
10 gallons	A,B	6-A
20 gallons	A,B	12-A
50 gallons	A,B	30-A

EXAMPLES:

Foam extinguisher, rated 2-A,4-B. This appliance should extinguish approximately twice as much Class "A" fire as a 1-A appliance, and four times as much Class "B" fire as a 1-B appliance. Also, the extinguisher should extinguish a fire in a deep-layer flammable liquid, such as a dip tank having a surface area of 4 square feet, when used by an average operator.

Dry chemical extinguisher, rated 6-B,C. This appliance should extinguish approximately six times as much Class "B" fire as a 1-B unit and should successfully extinguish a deep-layer flammable liquid fire of 6 square foot area when used by an average operator. It also is safe to use on fires involving electrical equipment.

61. GENERAL

611. All first aid fire extinguishers and extinguishing systems shall be of approved types as listed by the Underwriters' Laboratories, Inc., or other nationally recognized authorities, and shall be approved by U. S. Coast Guard for Merchant Vessels.

62. EQUIPMENT

621. All outboard powered boats should carry at least one first aid fire extinguisher.

(a) On boats having an enclosed galley, two extinguishers of suitable type shall be carried, one of which shall be convenient to the galley area and the other to the helm position.

(b) On runabouts with enclosed areas or false flooring, one IB extinguisher shall be carried convenient to the helm position.

(c) On cruisers under 35 ft., two IB extinguishers are recommended — one located convenient to the helm and one convenient to cabin.

Fire Protection Standards —Continued

(d) On cruisers more than 35 feet long, fire extinguishing equipment as recommended in Part I, Table X should be carried.

622. In addition to the recommended portable fire extinguisher equipment, a fixed carbon dioxide extinguishing system is recommended for machinery spaces, separate compartments for fuel tanks, bilges and galleys.

TABLE X.
NUMBER AND DISTRIBUTION OF FIRE EXTINGUISHERS

Typ* of Boat	CfOM of Extinguish*!*	Minimum	ft	nd* d
			locatioM	
Open boats under 16 ft.	1/2-B	1	Helmsman's position.	
Open boats over 16 ft.	1/2-B	2	Helmsman's position and passenger space.	
Boats under 35 ft.	1-B	2	Helmsman's position and cabin.	
Boats 35 ft.—45ft.	1-B	3	Near engine, helmsman's position and galley.	
Boats 46 ft.—55ft.	1-B	4*	Near engine, helmsman's position, crew quarters and galley.	
Boats 56 ft.—75ft.	1-B	5*	Near engine, helmsman's position crew quarters and galley.	
Boats 76 ft—100ft.	1-B	6*	Near engine, helmsman's position crew quarters and galley.	

* Where more than three 1-B units are recommended, the extinguishing capacity may be made up of a smaller number of larger units; e.g. three 2-B units may be used in lieu of 4, 5 or 6 of the smaller 1-B units.

(a) The quantity of gas required for such systems by Underwriters' Laboratories, Inc., is:

Volume of Space (cu. ft. net)	Carbon Dioxide in lbs.
140	10
220	15
300	20
375	25
500	35
800	50
1,200	75
1,600	100

and up to 4,500 cu. ft. at the rate of 1 lb. of gas per 18 cu. ft. of space and above 4,500 at 1 lb. per 20 cu. ft.

(b) Where bilges are open or communicating to more than one space, such spaces together with bilge shall be considered as one in determining the capacity of the system.

(c) Systems may be manually or automatically operated.

63. INSTALLATION.

631. Portable fire extinguishers shall be placed so that they are readily accessible from outside the compartment which they are intended to serve.

(a) Securing provisions must permit ease of release compatible with the requirements of ready accessibility.

632. Fixed carbon dioxide extinguishing systems shall be installed in accordance with the *Standards for Carbon Dioxide Extinguishing Systems (NFPA No. 12*)* insofar as they apply, and comprehensive printed in-

structions with labeled diagrams covering details of proper installation, shall be furnished by the manufacturer.

- (a) Carbon dioxide cylinders shall be mounted so as to avoid contact with moisture or wet surface to reduce danger of corrosion.
- (b) Manual controls shall be placed so they are readily accessible from outside the spaces served by the system.
- (c) Dual manual controls, well separated, are recommended irrespective of whether system is designed for manual or automatic operation.
- (d) Spaces to be protected by such systems should be enclosed and contain only the usual number of ports, companionways and door openings.
- (e) System may be designed for any one of the following plans of application, of which plans (1) and (2) are preferred:
 - (1) Independent systems installed to cover the various spaces required.
 - (2) Single system of sufficient capacity for all required spaces simultaneously.
 - (3) Single system of sufficient capacity for the largest required space, distributed by direction valves at the controls.
- (f) The provision of a device arranged to stop the engine simultaneously with the operation of the extinguishing system is recommended.

CHAPTER 7 **OPERATION AND MAINTENANCE**

71. HULL.

711. The entire boat shall be kept clean and shipshape.

- (a) Frequent flushing^ and cleaning of bilges is recommended.
- (b) Clean waste and rags should be stowed in metal containers or metal lined lockers. Similar receptacles shall be provided for waste and rags coated with oil, paint, paint remover, or polish; and such accumulation shall be kept to a minimum by frequent disposal ashore.
- (c) Foul weather clothing should be hung loosely in well ventilated lockers.
- (d) Paint and varnish removers are generally highly flammable and particular caution should be exercised during use of such to see that there is ample ventilation and no open lights, fires or smoking.
- (e) Naked lights (open flames), however small, shall not be carried into compartments where gasoline vapor may be present.
- (f) Gasoline or other flammable solvents shall not be used for cleaning purposes.

712. The ventilation system must be maintained at top efficiency.

- (a) Ventilation ducts should never be blocked off and any screening used in cowl or duct openings should be kept clear.
- (b) If power exhaust blowers are installed they should be operated at least five minutes before starting engines or main auxiliary engines.
- (c) Ventilate (open) entire boat before starting.

72. ENGINES.

721. Engines should, at all times, be maintained in the best operating condition in accordance with the manufacturer's instructions.

Fire Protection Standards — Continued

- (a) Engines should be inspected frequently for signs of fuel leakage or fuel vapors. The detection of either should be cause for corrective action.

73. FUEL SYSTEMS. - Permanently installed type.

730. Gasoline vapors are heavier than air and will not escape from low lying pockets, such as bilges or tank bottoms unless drawn or forced out. An atmospheric concentration of gasoline vapor as low as 1/4 per cent is sufficient to create a mixture which may be exploded by a slight spark.

731. The entire fuel system, tanks, piping (including tank vent line) and accessories shall be frequently checked for leaks or evidence of corrosion.

- (a) All connections shall be maintained tight at all times.
- (b) Fuel carried on board outside of fixed fuel system shall be in an approved safety container or in a portable tank as provided by manufacturers of outboard engines and shall be safely stowed outside of engine or living compartments.

732. Utmost care shall be exercised during fueling operations.

- (a) Fueling should never be undertaken at night except under well lighted conditions.
- (b) During fueling operations, smoking shall be forbidden on board or anywhere nearby.
- (c) Before opening tanks the following precautions shall be observed.
 - (1) All engines, motors, fans shall be shut down.
 - (2) Galley stoves shall be extinguished. (Coal fires shall be banked.)
 - (3) All ports, windows, doors and hatches shall be closed.
 - (4) Quantity of fuel to be taken aboard shall be determined in advance of fueling operations.
- (d) The fuel delivery nozzle shall be put in contact with the fill pipe before the flow of fuel is commenced and this contact shall be continuously maintained until the flow has stopped. There is a serious hazard from static discharge unless this rule is observed.
- (e) Tanks shall not be completely filled. Allow a minimum of 2 per cent of tank space for expansion. This space allowance should be 6 per cent if the fuel taken aboard is 32°F or below in temperature.
- (f) After fuel flow has stopped:
 - (1) Fill cap shall be tightly secured.
 - (2) Any spillage whatsoever shall be wiped up completely.
 - (3) Entire boat shall be opened and allowed to ventilate for at least five minutes before starting any engines or lighting galley fires.

74. COOKING, HEATING AND AUXILIARY APPLIANCES.

741. All flame operated equipment shall be kept clean and maintained in accordance with the manufacturer's instructions.

- (a) Gasoline shall not be used for priming alcohol or kerosene burners, nor shall gasoline or other flammable liquid be used for lighting-off coal, charcoal or wood stoves.
- (b) Alcohol, kerosene and fuel-oil burner tips shall be kept clean to avoid choke, extinguishment and consequent flooding.
- (c) Burners shall not be primed while hot.
- (d) Reserve fuel shall be limited to minimum needs and carried only in approved safety containers, stowed in a safe location outside engine compartment.

742. Printed instructions and labeled diagrams for the operation and maintenance of liquefied petroleum gas systems shall be available on board for ready reference.

- (a) Only the kind and specification of gas for which the system is designed shall be used. The gas should be obtained from sources authorized by the manufacturer of the system.
- (b) Particular care shall be taken against snuffing a flame from boilover, gust of air or any other cause.
- (c) Changing of cylinders shall be in accordance with the instructions which follow and under the supervision of licensed personnel when such officers are carried, or by other responsible person when no such officers are carried.

For single cylinder systems:

- 1. Close stop valves on cylinder and burn out gas content in line by lighting all burners.
- 2. When burners go out shut them off — *This is imperative.*
- 3. Disconnect empty cylinder, leaving stop valve closed and connect the full one.

For multi-cylinder systems:

- 1. Close both the cylinder stop valve and the stop valve in the line to the regulator.
- 2. Burn out gas content in low pressure lines and proceed with cylinder change as in single cylinder system.

For both types of systems:

- 1. After turning on a full cylinder, it is recommended that all burners be lighted for sufficient time to insure that there is no air in the lines to interrupt a continuous flow of gas; then shut off burners and cylinder stop valve and test for leaks with soap suds.
- (d) Frequent (bi-weekly recommended) tests of the entire system at service pressure shall be made by closing cylinder valves and observing the gage. If tight there should be no noticeable drop in ten minutes. Trial for location of leaks shall be made with soap suds and *never with flame.*
- (e) Empty cylinders shall be kept closed by the means provided (stop valves or plugs) whether or not connected and unconnected empties put ashore as soon as practicable.

75. ELECTRICAL SYSTEM.

751. Frequent inspection should be made of all electrical equipment and wiring to insure against deterioration and faulty conditions such as loose connections, insulation failure, burned switching contacts, fuse replacements, bonding effectiveness, etc.

- (a) Battery terminals should be kept clean of corrosive deposits.

76. FIRE EXTINGUISHERS.

761. Neither carbon dioxide nor vaporizing liquid (carbon tetrachloride or chlorobromomethane) fire extinguishers should be discharged into closed compartments while occupied by persons, as their effects may prove dangerous to life.

762. Soda-acid, foam and anti-freeze type extinguishers shall be discharged, cleaned, inspected for mechanical defects or serious corrosion, and recharged annually.

763. Vaporizing liquid extinguishers of the hand pump type shall be examined at regular intervals — several times a year — to make sure they have not been tampered with, to detect any injuries and to see that they are full,

- (a) A small amount of liquid should be discharged to check operation of the unit and the extinguisher again refilled.

Fire Protection Standards — Continued

- (b) If the discharged liquid is to be reused it should be directed into a clean dry receptacle.
- (c) Only refill liquids furnished by the extinguisher manufacturer should be used.

764. Stored pressure and cartridge type vaporizing liquid fire extinguishers shall be inspected at regular intervals in strict accordance with maintenance instruction found on the name plate of the device,

- (a) Only liquid furnished by the extinguisher manufacturer should be used.

765. Dry chemical fire extinguishers shall be kept full with specified weight of chemical at all times. Cartridges shall be reweighed annually and if found to weigh less than the minimum weight stamped thereon shall be replaced with a full one or recharged.

- (a) Extinguishers of this type shall be refilled after use even though only partly discharged.
- (b) Before recharging, hose shall be cleared of all chemical.

766. Carbon dioxide type fire extinguishers and cylinders in fixed carbon dioxide systems shall be reweighed at least annually, but preferably every six months and if found lighter than the weight indicated on the name plate shall be made tight and recharged,

- (a) Extinguishers of this type must always be recharged after use even though only partly discharged.

77. EMERGENCY EQUIPMENT.

771. Pyrotechnics carried as emergency equipment shall be stored in a dry place in a waterproof metal box or locker.
